Well-Being of Grandparents in Germany

Inauguraldissertation

zur

Erlangung des Doktorgrades

der

Wirtschafts- und Sozialwissenschaftlichen Fakultät

der

Universität zu Köln

2019

vorgelegt

von

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Well-Being of Grandparents in Germany

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Tag der Promotion: 29. Oktober 2019

Danksagung

Eine Doktorarbeit anzufertigen ist eine persönliche Herausforderung. Ein Wissenschaftssytem, das—wie allen Verantwortlichen bekannt ist—durch unsichere Berufsperspektiven und einen enormen Leistungsdruck gekennzeichnet ist, macht ein solches Vorhaben nicht einfacher. Die erste „Paper rejection“ kann somit schnell zu einer kritischen Lebenssituation führen. Umso wichtiger ist es, dass man sowohl beruflich als auch privat von Menschen begleitet wird, die einem bei allen Hochs und Tiefs zur Seite stehen. Einer kleinen Auswahl dieser Menschen möchte ich im Folgenden für ihre Unterstützung danken.

Als erstes danke ich meinem Betreuer Karsten Hank für die gute Zusammenarbeit sowohl auf fachlicher als auch persönlicher Ebene. Dein Feedback war stets klar, konstruktiv und somit extrem hilfreich. Nach unseren Gesprächen wusste ich immer, was die nächsten Schritte sind. Eine solche Betreuung ist nicht immer selbstverständlich bei einer Promotion. Ich danke Lea Ellwardt, die erst zum letzten Drittel meiner Promotionsphase die Betreuung mit übernommen hat. Deine fachliche Kompetenz und deine unkomplizierte und herzliche Art waren eine große Unterstützung. Ich danke euch beiden für das in mich gesetzte Vertrauen.

Ich danke Christof Wolf für hilfreiche Kommentare zu einzelnen Kapiteln und dafür, dass du mir die Zeit gewährt hast, die ich zur Fertigstellung der Doktorarbeit benötigt habe. Ich danke Alexander Schmidt-Catran, Philipp Lersch und Michael Kühhirt für die Unterstützung, vor allem bei methodischen Fragen konnte ich mich immer auf euch verlassen. Ich danke allen Verantwortlichen, die einen Forschungsaufenthalt am Deutschen Zentrum für Altersfragen (DZA) ermöglicht und mich während dieser Zeit unterstützt haben. Dies gilt insbesondre für Katharina Mahne und Martin Wetzel. Ich möchte auch meinen Koautoren für die gemeinsame Arbeit danken, many thanks to Valeria Bordone and Bruno Arpino for their great work on our joint paper.

Für die gemeinsame Zeit beim Graduiertenkolleg GROW danke ich allen Kolleginnen und Kollegen, insbesondere Regina Hilz, Katrin Alert, Andreas Bergholz und Nathalia Schulz. Mein Dank gilt auch den Doktorandinnen und Doktoranden am Institut für Soziologie und Sozialpsychologie, die mich auf einem Teil des Weges begleitet haben. Ein besonderer Dank—auch für den moralischen Beistand in der Endphase—gilt Jana Mäcken und Jonathan Wörn.

Es gibt eine Reihe toller Menschen in meinem Leben, die ich in der Schule, im Studium und darüber hinaus kennengelernt habe. Vielen Dank für eure Freundschaft! Ich kann euch nicht alle einzeln aufzählen, aber ich bin mir sicher das sich die Richtigen angesprochen fühlen.

Schließlich danke ich meiner Familie. Meinen streitlustigen Großeltern, meinen liebevollen Eltern und großartigen Brüdern. Selbstverständlich danke ich auch meinen Tanten und Onkeln, die mich immer unterstützt haben, sowie der restlichen Chaoten Bande, allen Cousins und Cousinen.

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1 Introduction

1.1 Grandparenthood as a Social Phenomenon

Over the course of the 20th century, increasing life expectancy has created the potential for people to live long enough to experience the transition into grandparenthood, and it has increased the shared life span between grandparents and grandchildren. Thus, grandparenthood has received enormous attention as a social phenomenon. Even a quick online search shows that a series of civil society initiatives deal with grandparenthood. For instance, I discovered an online advisor (www.grosseltern.de), a Swiss lifestyle magazine that particularly addresses grandparents (www.grosseltern-magazin.ch), as well as self-established supportive groups (such as Bundesinitiative Großeltern [BIGE]) for grandparents who involuntarily have lost contact with their grandchildren. The relevance of grandparenthood is also mirrored in a great body of scientific research conducted in the last decades. Early studies were even published since the 1950s (Apple, 1956; Kivnick, 1981; Neugarten & Weinstein, 1964).

In the following, I describe the demography of grandparenthood in more detail and how it overlaps with other domains in later life, which is the starting point of this dissertation. From this, I derive the central research questions and briefly explain their relevance.

Longevity goes hand in hand with various changes in the way that people live together, especially regarding intergenerational relationships outside and within the family. However, family structures are shaped through further demographic processes. Fertility rates, timing of births over the course of life, and mortality can have cumulative or opposing implications on the occurrence of grandparenthood. On the one hand, the number of childless people has risen (Frejka & Sobotka, 2008), and as a result, the proportion of parents who never experience grandparenthood has also increased. Furthermore, the birth of the first child has shifted into later life years, causing a delay in grandparenthood. Thus, the shared life span between grandparents and grandchildren has decreased again (Leopold & Skopek, 2015a; Margolis, 2016).

Even considering the delay of grandparenthood, once grandchildren are born, people exhibit grandparenthood for quite a long time. In Germany, the shared life span ranges from 20 to more than 30 years, which marks a considerable span during the second half of life. Demographic

research has contributed a detailed picture to that issue. For Germany—which is the focus of this dissertation—it is necessary to differentiate between West and East (the former German Democratic Republic) Germany. In West Germany, the median age at the transition to grandparenthood is 56 years for women and 59 years for men. In East Germany, the median age is 48 years for women and 51 years for men. To estimate the shared life span Leopold and Skopek (2015b) have calculated the difference between further life expectancy at age 60 and the median age at the birth of the first grandchild. In West Germany, this amounts to 28 years for women and 21 years for men. In East Germany, women can expect to share 36 years with their grandchildren while men can expect 29 shared years (Leopold & Skopek, 2015b).

On average, grandparents can experience this common life span in an active way while they are still in good physical and mental shape. That is connected to the fact that the increasing life expectance comes with an increase in healthy years (Margolis & Wright, 2017). This argument also applies to other central areas in life, which overlap with grandparenthood. One example is employment: For women in East Germany, there are on average 10 years between the birth of the first grandchild and the transition to retirement. For men in West Germany, there is still an average overlap of 2 years (Leopold & Skopek, 2015b). Even after retirement, other areas within and outside the family may be important in addition to the grandparent role, in which people can engage in productive activities, such as volunteering, informal care for disabled people, or leisure activities. Combining all this, one can say that "In today's world, people can expect to spend several decades in the grandparent role during some of which they are still both employed and/or otherwise active in many areas of their lives" (Muller & Litwin, 2011: 109).

Taking this development into consideration, this dissertation deals with grandparents who enact their grandparent role by providing care for their grandchildren, which is considered as an informal productive activity within the family. In this context, grandparents are often seen as an important resource within the family and in society. They can step in if public care is not sufficient, such as to guaranty the employability of their children (the middle generation). At the same time, this raises questions concerning the consequences grandparents face, especially regarding health and well-being, which are promoted as key policy objectives for aging populations (WHO, 2015). Numerous studies have thus far investigated the implications of providing grandchild care on grandparents' health and well-being, and related outcomes, such as cognitive functioning, subjective age, or social participation. For supplementary grandparenting, only a few studies point to negative consequences (Brunello & Rocco, 2019;

Szinovacz & Davey, 2006). Some studies have pointed to a positive association with health and well-being (Arpino, Bordone & Balbo, 2018; Di Gessa, Glaser & Tinker, 2016a; Di Gessa, Glaser & Tinker, 2016b; Hughes, Waite, LaPierre & Luo, 2007; Musil et al., 2013). Other studies largely question whether there is a causal effect (Danielsbacka, Tanskanen, Coall & Jokela, 2019; Reinkowski, 2013; Sheppard & Monden, 2019). Overall, the state of research is still unclear, which is why research conducted in this dissertation is necessary.

Although the research findings are widely contradictory, especially studies with a cross-sectional framework have pointed to a positive association between grandchild care and health or well-being. That could encourage policy maker and professionals in the field of applied gerontology and social work to promote grandchild care, because they assume positive outcomes. This is problematic, when the corresponding evidence is based on studies that are methodologically not rigorous enough and when the evidence is not clear. One reason for this is that even studies operating with longitudinal data apply cross-sectional analyses by comparing grandparents who provide grandchild care with those who do not; therefore, these studies do not sufficiently address selection into grandchild care, meaning that rather privileged people with better health and well-being might be more likely to provide grandchild care (see Chapter 1.4). Thus, it is not possible to draw causal conclusions and derive policy implications from such findings. In this dissertation, I use a longitudinal analysis approach and investigate how changes over time in grandchild care status lead to changes in health and well-being within the same person. This contributes to the inconclusive literature and helps to better understand the link between grandchild care and outcomes like health and well-being.

In the first study (Chapter 2), the central research question follows: *Does a within-person change in the provision of grandchild care influence grandparents' health?* Previous research on this topic considered different dimensions of health (e.g. mental, physical, and functional), which makes it difficult to accumulate evidence. From my point of view, research should first identify if there is a health effect at all, before investigating different dimensions of health. Self-rated health is particularly suitable for this purpose, because it is a well established and generic measure of health (Jylhä, 2009; Singh-Manoux et al., 2006). Furthermore, although it is a subjective measure, it is acknowledged as a robust predictor for mortally (Idler & Benyamini, 1997; Jylhä, 2009).

In the second study (Chapter 3), I combine the literature on grandchild care (as an informal productive activity) with the literature on formal productive activities (such as volunteering),

which are largely unrelated to each other. The corresponding research question follows: *How is grandparental childcare combined with further productive activities within and outside the realms of the family, and how does these combinations matter in terms of life satisfaction?* This is relevant, because (as described above) under today's demographic and socio-economic conditions, grandparenthood might be one important—but not the only important—role that people take on in the second half of their lives. Looking at the implications for life satisfaction, which represents a cognitive dimension of well-being, might help to understand how grandparents want to arrange their lives within and outside the realms of the family.

In the third study (Chapter 4), the research question follows: *Does grandparenthood and grandchild care compete with or add to grandparents' involvement in leisure activities, and does it influence with whom these activities are carried out?* Many studies investigate the consequences of grandchild care, although in Europe, only an average of 50% of grandparents provide care for their grandchildren (Igel & Szydlik, 2011); in Germany, that average is only around 30% (Mahne & Klaus, 2017). In this study, I contribute to the existing literature by not only investigating the implications of grandchild care but the changes related to the transition into grandparenthood. Instead of looking at health and well-being directly, I am interested in whether and how grandparenthood influences people's everyday lives. By investigating leisure activities, one can approach to what extent changes in everyday life can occur through grandparenthood. Furthermore, this outcome is related to health and well-being.

Role strain and *role enhancement* theory are central conceptual approaches conducted in this investigation. They deal with consequences of *multiple role occupation* and as already highlighted grandparenthood is considered as a central role, which is however intertwined with other roles people might enact in later life. Furthermore, *gender* is another central perspective through which to approach the described research questions. In this respect, research shows that patterns of productive activities (including grandparental childcare) and social expectations related to such activities are still gendered (Choi, Burr, Mutchler & Caro, 2007). Thus, the consequences on health and well-being might be gendered as well.

The three research questions are addressed in three separate empirical studies. They are included in Chapters 2 through 4. In the remainder of this first chapter, I briefly discuss central conceptual and empirical aspects that will lead to the subjects of the three studies. First, I start with some general considerations to define more closely the subject of this dissertation (Chapter 1.2). Second, I provide an overview on the literature on grandparenthood to highlight its

multidimensional character and how it is related to other important areas in life (Chapter 1.3). Fourth, I link the grandchild care topic to the more general discussion on "successful and productive aging" (Chapter 1.4) and then discuss aspects of multiple-role occupation and gender (Chapter 1.5). Thereby, I briefly present theoretical explanations why grandparenthood and grandchild care might influence health, well-being and related outcomes. Fifth, I summarize the three studies (Chapter 1.6), and finally draw a conclusion (Chapter 1.7).

1.2 General Considerations on the Research Subject

This dissertation focuses on supplementary grandchild care in Germany for the following reasons.

Many European studies in this field of research are based on data from the Survey of Health, Ageing and Retirement in Europe (SHARE). As research seeks to cumulate knowledge to gain more generalizable statements, it is valuable to apply different data, although in this case national data narrows the scope of the study. Germany is particularly suitable for this purpose. First, the DEAS is a high-quality longitudinal study with a sufficiently large sample. More importantly, Germany occupies an intermediate position in the European context when it comes to family relations (Aartsen, van Tilburg, Smits & Knipscheer, 2004; Lohmann & Zagel, 2016), which might permit a certain generalizability. In contrast, northern European countries are characterized by high defamilialization (e.g., public care services are well developed), while southern European countries are characterized as more family-based welfare states (e.g., care work relies more strongly on family networks).

A further restriction concerns the extent of grandparents providing grandchild care. In the USA, a relevant number of grandparents have primary and custodial responsibilities for their grandchildren (U.S. Census Bureau, 2014). Often, the parents (middle generation) are absent and the grandparents take over the vacant role. Such situations are often associated with negative consequences for the grandparents (Hayslip & Kaminski, 2005) and are not comparable to situations when grandparents have a supplementary care role. The latter is the central social phenomenon in Europe and in Germany (Di Gessa et al., 2016; Hank & Buber, 2009). Primary grandchild care plays a minor role in the European context and a negligible role in the German context. This dissertation is therefore about supplementary grandchild care. For reasons of legibility, I generally use the term grandchild care without the prefix supplementary. I use the term primary grandchild care when comes to full-time care.

Grandparenthood and grandparental childcare play an important role in other regions of the world. In Asian countries, for example, there is also a considerable body of literature on this subject (Ku, Stearns, van Houtven & Holmes, 2012; Ku et al., 2013; Tsai, Motamed & Rougemont, 2013; Zhou, Mao, Lee & Chi, 2017). Considering these aspects is not intended for this dissertation.

1.3 Dimensions of the Grandparent Role

Next to the demography of grandparenthood, psychologists and sociologist have discussed grandparenthood as a personal and social role. From a developmental psychology perspective, grandparenthood is discussed under the framework of generativity (Thiele & Whelan, 2006). It is defined as commitment and support for future generations (Erikson, Erikson & Kivnick, 1986). Grandparenthood has been discussed as an opportunity to develop such commitment while having intergenerational contact with offspring (Thiele & Whelan, 2006). Based on E. H. Erikson's work, generativity was conceptualized as a developmental task of the middle-age, but due to both theoretical considerations and increasing longevity, later work has also highlighted the relevance of generativity for the early stages of old age (Villar, 2012).

The sociological (and predominate) framework that is applied in the grandparenthood literature is role theory (Muller & Litwin, 2011). A role is a structural position that a person holds within a social group. According to symbolic interactionism, social roles are not simply "ascribed" but are "achieved" (Silverstein & Marenco, 2001: 497). This means that people do not simply occupy social roles; they perform/enact and negotiate them in everyday interactions and actively integrate them into their concept of self (Mahne & Motel-Klingebiel, 2012; Muller & Litwin, 2011; Silverstein & Marenco, 2001). This process of role enactment is relevant when it comes to a gendered perspective on grandparental childcare, as care activities in general are still predominately associated with a female-caregiver role.

Grandparents can enact their role across different dimensions. In this regard, there are various approaches not only for grandparenthood in particular (Kivnick, 1983; Neuberger & Haberkern, 2014; Silverstein & Marenco, 2001) but for intergenerational relationships in general (Bengtson & Roberts, 1991). From my point of view they differ only in detail. In essence, three dimensions can be identified: the behavioral, attitudinal and the affective dimension (Mahne & Motel-Klingebiel, 2012).

The *attitudinal* dimension addresses the importance of the grandparent role and how central it is compared to other roles or the perceptions of role obligations related to grandparenthood. Research has shown that the role of grandparents is seen as highly important (Reitzes & Mutran, 2004). For Germany, Mahne and Motel-Klingebiel (2012) provide evidence that 40% of the grandparents rate the grandparental role as important, and 51.8% rate it as being very important. Only 6.6 % say that this role is not all that important, and 1.6% note that the role is completely unimportant to them. The authors cannot find any significant differences in the importance ranking between gender and social class. These values are very high, even when assuming an overestimation due to social desirability. Even a high share of nongrandparents anticipate the importance of the grandparent role in later life. A total of 58.9% of people over 40 years of age say that becoming a grandparent is important or very important to them (Mahne & Motel-Klingebiel, 2012). Furthermore, people perceive high expectations that are related to the grandparent role. Although there is variation between European countries, on a scale from zero to 10, the country's mean ranges only from 6.4 to 9. The country mean for Germany is 8.12 (Neuberger & Haberkern, 2014). Studies show a positive association with grandparents' well-being, especially when grandparents strongly identify with their role (Reitzes & Mutran, 2004). However, it is again important to acknowledge that the grandparent role overlaps with other areas in life (Silverstein & Marenco, 2001). Bearing this in mind, research has also shown that the grandparent role does not occupy an exclusive position. This means that other roles (located outside the family sphere) are also important in later life (Muller & Litwin, 2011).

The *affective* dimension addresses the relationship quality between grandparents and grandchildren. Research points to a good relationship quality with close bonds, where conflicts do not play a major role. In Germany, 69.7% of grandparents state that they have a close or very close relationship with their adult grandchildren, 17.5% report a medium–close relationship, and only 12.8% report that they have no close relationship with their adult grandchildren. A total of 91.8% of the grandparents report that they seldom or never have conflicts with their adult grandchildren (Mahne & Klaus, 2017). The quality of the relationship can be moderated by different factors. Grandmothers have on average a better relationship to their grandchildren than grandfathers, and maternal grandparents better than paternal grandparents (Dubas, 2001). If the middle generation has a good relationship to their parents, then the relationship between grandparents and grandchildren will be better (Mueller & Elder, 2003; Whitbeck, Hoyt & Huck, 1993). A close relationship with grandchildren seems to be positively associated with grandparents' well-being (Drew & Silverstein, 2007; Mahne &

Huxhold, 2015). In contrast, there is a negative association with the psychological well-being of grandparents if they lose contact with their grandchildren (Drew & Silverstein, 2007). Arpino, Bordone and Balbo (2018) investigate the relevance of grandparenthood per se and the number of grandchildren; both aspects are positively related with grandparents' subjective well-being. Although the relationship with grandchildren is important, research has also shown that in recent decades, relationships with friends have become increasingly important. The DEAS's findings show that an increasing number of people in the second half of life have more friends in their inner network, spend more leisure time with them, and receive emotional support from them (Böger, Huxhold & Wolff, 2017).

Mutual intergenerational help, such as financial transfers (see for instance Hoff (2007)) and contact frequency between generations, are aspects of the *behavioral* dimension of the grandparent role. The DEAS analyses for 2014 show that 29% of grandparents have contact with their adult grandchildren on a weekly basis, and 29.3% have such contact on a monthly basis. A total of 41.7% have less contact with their grandchildren. The frequency rates were slightly higher in 2008. Overall, grandparents have more contact with their children than with their grandchildren (Mahne & Klaus, 2017). The central aspect of grandparenthood in this dissertation is grandparents' involvement in childcare, which is also a behavioral dimension of the grandparent role. The share of grandparents providing grandchild care in Germany was 33.7% in 1996, 28.4% in 2002, 24.7% in 2008, and 30.2% in 2014. Although there were fluctuations between the years, these values indicate a stable share of about 30%. In principle, grandmothers provide more care than grandfathers do. In addition, the trend suggests that the proportion of those who combine the care of grandchildren with other productive activities (employment and voluntary work) is increasing. This is especially the case for women (Mahne, Wolff, Simonson & Tesch-Römer, 2017).

1.4 Grandparental Childcare and the Paradigm of Successful and Productive Aging

Being old does not necessarily go hand in hand with illness, decline, and loss (Baltes & Carstensen, 1996). In fact, gerontological research has shown that being old has many different facets and that aging is a multi-directional process featuring losses and gains. To overcome negative images of aging, Rowe and Kahn (1997) developed their framework of "successful aging." They define it as having a "low probability of disease and disease-related disability, high cognitive and physical functional capacity, and active engagement with life" (Rowe &

Kahn, 1997: 433). The core assumption is that being active will help older adults maintain functional (physical and cognitive) capacities and promote health in later life. Over time, additional concepts have been derived from the original framework, such as active or productive aging. These concepts have different emphases. In principle, however, they follow the same logic, which is why they can generally be addressed as the "successful and productive aging" paradigm. Until today, this paradigm has dominated the discourse in gerontological research. Consider, for example, that just a few years ago, two of the most influential journals in the field of social and behavioral gerontology published special issues on this subject: *The Gerontologist* (Pruchno, 2015) and *The Journals of Gerontology: Series B: Psychological and Social Sciences (Pruchno & Carr, 2017).* A significant part of the literature is concerned with criticism of this concept, a systematic review of this criticism is provided by Martinson and Berridge (2015). I will only focus on aspects that are important to the empirical studies contained in this dissertation. Among other things, critical gerontologists have criticized the individualistic perspective of the paradigm. It highlights the responsibilities of the individual to engage in productive activities to function as a valuable member of society, which will in turn help promote personal health and well-being. Some researchers see parallels to a general neoliberal development in the social sciences that have become more and more dominant since the 1980s and in which the individual is seen "as the key to social action" (Rubinstein & Medeiros, 2015: 40). Such a perspective neglects structural inequalities (Estes, 2001) across the life-course based on the social categories class, sex/gender, ethnicity, and age—which influence the opportunities and the capacities to meet productivity expectations. Empirical research shows that socioeconomic resources and gender influence whether productive activities are carried out and that gender influences which kind of productive activities people engage in (Burr, Mutchler & Caro, 2007; Choi, Burr, Mutchler & Caro, 2007; Hank & Erlinghagen, 2010; Musick & Wilson, 2010).

Although this theoretical perspective is relevant for all three studies, the first study (Chapter 2) will translate this argument—that productive activities are carried out predominately by privileged groups in society—into methodological considerations to identify causal effects. The majority of the literature on grandparenting neglects corresponding aspects.

1.5 Gender and Multiple Role Occupation

Against the background of successful and productive aging, grandparental childcare can be conceptualized as a productive activity located in the family system: "Considering its considerable (economic and noneconomic) societal value, it is indeed important to include productive aging activities within families (such as the provision of childcare) in assessments of older people's active engagement in society, which often tends to be limited to 'public' activities . . ." (Glaser & Hank, 2018: 221). This reference points out that productive activities can be carried out in the family sphere (predominately, housework and care activities with an informal character). In contrast, productive activities can also be located in the public sphere, where they are more institutionalized (e.g., formal volunteering in organizations, political and religious engagement, or educational training). Gender-specific patterns and role models can still be identified, with women being more active in the family household sphere (female caregiver role) and men being more active in the public space (male breadwinner role).

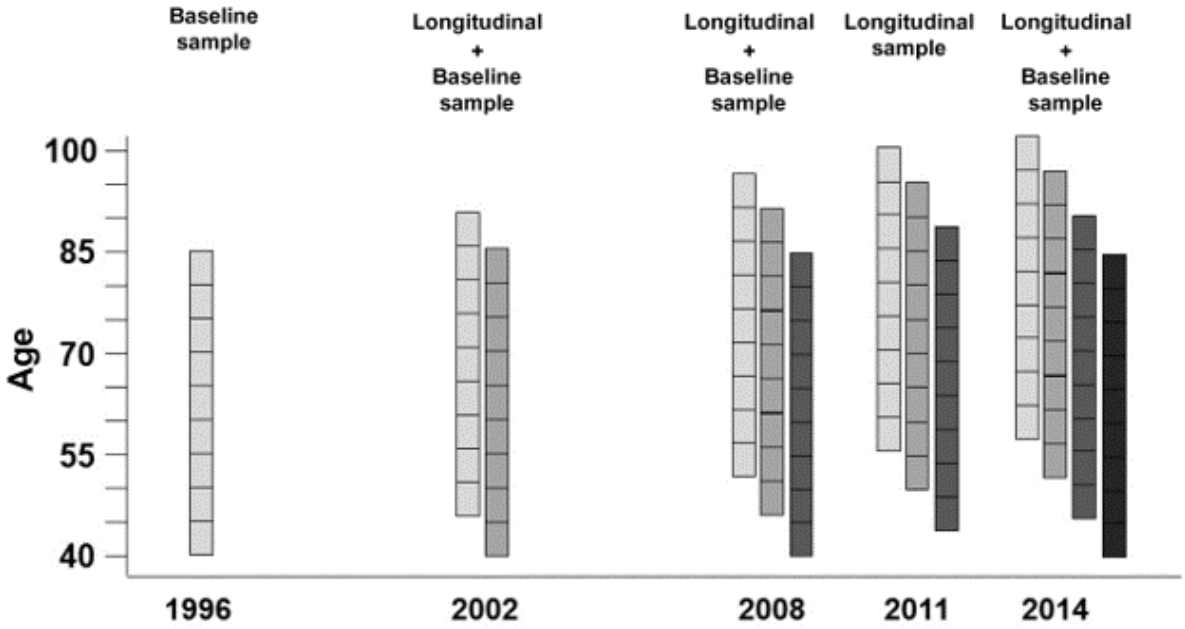
When it comes to multiple-role occupation (engagement in more than one productive activity) and its implications for health and well-being, role strain and role enhancement are the most common theoretical approaches with which to address such research questions (Rozario, Morrow-Howell & Hinterlong, 2004). Both models have opposing assumptions on the consequences of multiple-role occupation. Role strain is highlighting role overload and the conflicts that emerge from involvement in multiple roles, especially when it comes to highly demanding and time-consuming roles. Role overload and role conflict can cause stress, which can lead to adverse outcomes in health and well-being if a person is not able to cope with these burdens (Goode, 1960). Role enhancement assumes that multiple roles are buffering personal and interpersonal tension rather than causing stress. Sieber (1974) classifies four types of benefits from role accumulation: ". . . (1) role privileges, (2) overall status security, (3) resources for status enhancement and role performance, and (4) enrichment of the personality and ego gratification" (Sieber, 1974: 569). From this point of view, multiple-role occupation is associated with having a positive impact on health and well-being. In terms of grandparental childcare, researchers can argue with role strain and consider the caregiving role as being an additional demanding obligation that might deteriorate grandparents' health and well-being. In contrast, according to role enhancement, researchers assume that grandparental childcare can improve grandparents' health and well-being or help maintain it through the aging process. In study two (chapter 3) and study three (chapter 4), I will argue that gender plays an important

role in whether grandparenthood and multiple-role occupation is experienced as role strain or role enhancement.

1.6 Summarizing the Three Studies

All studies are based on the DEAS. The DEAS is an ongoing large-scale, cohort-sequential data set that includes repeated cross-sectional and longitudinal surveys. The baseline samples are representative of the German population aged from 40 to 85 years. The DEAS started with a baseline survey in 1996. In 2002, a follow-up and a new baseline sample were conducted. Since 2008, the follow-up components have been conducted every three years, and new baseline samples are added every six years. The sample design is visualized in Figure 1; for detailed information on the DEAS, see Klaus et al. (2017). All three studies include different data components, which will be described in the corresponding section. Table 1 provides an overview of all conducted surveys.

Figure 1: DEAS Sample Design



Note: Baseline = newly selected sample; Longitudinal = each baseline survey is followed over time. Source: Klaus et al., 2017: 1105.

Table 1: Overview of the studies included in this dissertation

	Study 1 (Chapter 2)	**Study 2 (Chapter 3)**	**Study 1 (Chapter 4)**
Title	Does Grandchild Care Influence Grandparents' Self-Rated Health? Evidence From a Fixed-Effects Approach	Gendered Productive Activities Within and Outside the Family: Implications for Grandparents' Life Satisfaction	Changes in Leisure Activities Before and After Grandparenthood
Research Question(s)	Does grandchild care influence grandparents' self-rated health?	How is grandparental childcare combined with further productive activities within and outside the realms of the family? (How) does these combinations matter in terms of life satisfaction?	Do grandparenthood and grandchild care reduce or increase grandparents' involvement in leisure activities? Do grandparenthood and grandchild care influence with whom these activities are carried out?
Dependent Variables	Self-rated health	Life satisfaction	No. of leisure activities carried out on a regular and on a frequent basis Leisure activities carried out with relatives Leisure activities carried out with friends
Core Independent Variables	Grandchild care	Grandchild care Informal care Formal volunteering	Transition into grandparenthood Grandchild care
Data	DEAS 2008-2014	DEAS 1996-2014	DEAS 2002-2014
Statistical Units	Person-year observations (Timepoints nested within persons)	Person-year observations (Timepoints nested within persons)	Person-year observations (Timepoints nested within persons)
Statistical Method	Pooled OLS regression, pooled OLS with lagged-dependent variables, random-effects panel models, fixed-effects panel models	Random-effects panel models, fixed-effects panel models, inverse probability weighting	Fixed-effects panel models
Current Status	Published in Social Science & Medicine	Submitted to social science journal.	In preparation for journal submission.

Chapter 2, *Does Grandchild Care Influence Grandparents' Self-Rated Health? Evidence from a Fixed-Effects Approach*, investigates the relationship between supplementary grandchild care and grandparents' self-rated health. Furthermore, it deals with the methodological issues of previous research. As already discussed, the successful and productive aging paradigm highlights the importance of being active and productive to maintain health in later life. As a result, it neglects who is able to do so. This theoretical shortcoming can be translated to a methodological issue to identify the casual effects applying regression analysis. Therefore, it is necessary to meet the assumption of exogeneity. It requires that the corresponding explanatory variable is not correlated with the error term of the model. This assumption is violated if central covariates of the explanatory variable (observed or unobserved) are not included in the regression model. For example, if people with higher education levels exhibit a higher probability to provide grandparental childcare, education must be included as a control variable in the regression model. Otherwise, this self-selection into grandparental childcare would generate biased estimates of the effect of grandparental childcare on grandparents' outcomes. Another issue that can violate the assumption of exogeneity is reverse causality. For the research question this study explores, this means that health itself causes grandparent to provide grandchild care and not the other way around (healthy grandparents are more likely to provide grandchild care) In this chapter, I summarize the previous empirical literature and conclude that a) so far, the majority of the studies that investigate the association between grandchild care and grandparents' health are cross-sectional and do not address any of this two issues; b) some studies apply longitudinal data and address the reverse causality problem; and c) at the time this study was conducted, only three studies—to the best of my knowledge—addressed both issues. These studies showed that providing grandchild care has no effect on grandparents' health outcomes when selection into grandparental childcare is considered in the analysis. Controlling for reverse causality (through instrumental variable regression) did not change this finding. This suggests that research in this field should pay more attention to selection bias than to reverse causality. The opposite is the case. A longitudinal analysis mentioned in the second group of studies focuses on reverse causality by applying lagged-dependent models. These models include the outcome variable at t_{-1} as a control variable. However, research shows that lagged-dependent models do not solve the reverse causality issue, neglect the selection problem, and violate the assumption of exogeneity. Thus, the estimates could potentially be biased. In the study presented in chapter 2, I demonstrate this issue by comparing results of different regression models.

I apply the 2008 baseline survey of the DEAS and the corresponding follow-up surveys in 2011 and 2014. The sample is conducted as a strongly balanced panel and includes 625 individuals surveyed across all three waves (1.875 person–year observations).

In the first set of analyses, I run pooled OLS and pooled OLS models with lagged-dependent variables. Both models operate only with between-person variance and do not address the selection issue. Second, I apply random-effects panel models. This approach applies between- and within-person variance and partially controls for selection effects. The results of all these models indicate a positive and significant relationship between supplementary grandchild care and grandparents' self-rated health. Finally, I estimate fixed-effects panel models. This approach only applies within-person variance and controls for all person-specific, time-constant factors that could lead to selection into grandparental childcare, regardless of whether they were observed or unobserved. The corresponding effect is slightly decreasing and no longer significant.

Based on this analysis, I conclude that the positive association between supplementary grandchild care and grandparents' self-rated health reflects a selection effect rather than a causal effect.

Chapter 3, *Gendered Productive Activities within and outside the Family: Implications for Grandparents' Life Satisfaction*, examines how the combination of two productive activities effect the life satisfaction of grandparents from a gender perspective. I focus on grandparental childcare in combination with volunteering and in combination with informal care.

This study considers two normative expectations towards productive activities. On the one hand, the successful and productive aging paradigm indicates that a certain productivity expectation is placed on aged people. Such a productivity narrative addresses activities outside the family, such as formal volunteering, and is directed to both women and men in the same manner. On the other hand, social expectations toward productive (care) activities within the family are predominately addressed toward women. However, research shows that men are able to carry out care activities without neglecting other activities, such as volunteering. For women, care activities compete with volunteering. This makes it more difficult for women to meet social expectations within and outside the family compared to men. I therefore assume that women will perceive grandparental childcare as role enhancement, especially if they can combine it with volunteer work. I presume that providing grandchild care will increase the life satisfaction

of grandmothers and that this positive effect will be larger if grandchild care is combined with volunteering. For grandfathers, I assume that providing grandchild care will increase the life satisfaction of grandfathers, regardless of whether it is combined with volunteering. The combination of grandparental childcare and informal care for disabled people might be predominately associated with role strain for both men and women. The scope of activities is limited to care activities within the family, which may neglect other areas of activity. A double-care burden might also cause conflicts, as caregivers might be forced to prioritize between grandchildren and other family members with care needs. The combination of grandchild care and informal care is supposed to decrease life satisfaction.

For this investigation, I apply the DEAS baseline sample from 1996 (and the follow-up in 2002), the baseline sample from 2002 (and the follow-up in 2008), and the baseline sample from 2008 (and the follow-ups in 2011 and 1014). The analytical sample size slightly differs between the analyses for the combination of grandparental childcare and volunteering (N = 3,577 individuals and NT = 8,178 person–year observations) and grandparental childcare and informal care (N = 3,516 individuals and NT = 8,611 person–year observations), because in both cases, I drop observations of those who stop carrying out the corresponding activities. Thus, an effect can be identified that refers only to the initiation of an activity. In the first step, I estimate main effects (no interactions) and compare random- and fixed-effects models. In the second step, for the interaction effects, I rely on the fixed-effects approach, because both theoretical (selection) and statistical (Hausman test) arguments justify that. To adjust for sample selectivity, I use inverse probability weighting. All analyses are stratified by gender. To estimate the combined effects of productive activities, I include corresponding interaction terms.

For men, the results clearly show that there is no significant relationship between productive activities and life satisfaction in terms of grandchild care and informal care. A positive relationship between volunteering and life satisfaction is based on selection, not causation. The combination of activities is also not relevant for men's' life satisfaction. If grandmothers provide care for grandchildren and do not combine it with another activity, they experience a decrease in their life satisfaction. This negative effect vanishes if grandchild care is combined with volunteering or informal care. However, such an adverse consequence of providing grandchild care is most pronounced for the baseline sample from 1996, is weaker for the 2002

baseline sample, and is no longer present in the baseline 2008 sample. The combination of grandchild care and volunteering points in a positive direction but is not significant.

It seems that neither the role strain nor the role enhancement approach applies to men. The negative effect for women indicates that grandparental childcare is perceived as role strain when women do not have the opportunity to combine this activity with other activities. Based on theoretical argumentation, this was only expected for volunteering. For women in particular, the results remain unclear, and due to limited within-person variance, further analyses could not be obtained. For clarification, further research is needed.

Chapter 4 consist of the study *Changes in Leisure Activities Before and After Grandparenthood*, which examines whether grandparenthood and grandparental childcare in particular influence grandparents' leisure activities. This chapter contributes to the existing literature in two ways. First, a major part of the grandparenthood literature focuses on grandparental childcare. According to the concept of linked lives, grandchildren might influence the everyday life of their grandparents, regardless of whether they actively provide care. For this reason, as a first step, I consider the effects of grandparenthood per se. In the second step, I will consider grandparental childcare. Second, a few existing studies investigated if grandparental childcare competes with or adds to other activities. They mainly consider productive activities in a narrow sense, such as volunteering, engagement in political activities, or educational training. These are very specific activities and are carried out by selective groups in society. So far, no study investigates grandparents' involvement in leisure activities in a broader sense, which is a more suitable indicator of whether one is interested in how grandparenthood effects everyday life. This is also relevant because research shows that leisure activities are positively correlated with health and well-being, especially when they are carried out with others. People with diverse networks have better well-being compared to people with social relationships who are limited to the family context. They are generally in better health and ultimately live longer. Thus, this study considers not only to what extent leisure activities are carried out but with whom they are carried out.

With the DEAS data, I was able to consider how often a wide range of 13 different activities are carried out: doing arts and crafts, using a computer, doing crossword puzzles, gardening, playing board games, meeting friends, going to political meetings, doing sports, participating in artistic activities, visiting cultural events, visiting sporting events, and attending classes/lectures. Furthermore, for six of these activities, I can analyze with whom these

activities are carried out. I am particularly interested in whether activities are carried out with relatives or with friends.

In this study, I use a) the 2002 baseline survey and the corresponding follow-up in 2008 and b) the baseline survey from 2008 with follow-ups in 2011 and 2014. The baseline from 1996 is not applied because physical functioning as a central control variable was not measured before 2002. I generated three separate working samples to analyze a) the implications of grandparenthood per se (N = 1,503 individuals and NT = 3,634 person–year observations), b) the implications of recently started provision of grandchild care (N = 2,547 individuals and NT = 6,119 person–year observations), and c) the implications of continuous care over time (N = 2,862 individuals and NT = 6,898 person–year observations). I estimate fixed-effects panel models to consider selection into grandparenthood and grandparental childcare.

In summary, although there were some small but significant effects in the main analysis, the effects could not be supported in multiple robustness checks. I conclude that grandparenthood and grandchild care do not cause any major changes in grandparents' involvement in leisure activities.

Grandparenthood does not seem to be associated with any role strain that would lead to a reduction in leisure activities. Furthermore, grandparents who provide grandchild care manage to fulfill grandparental role obligations without reducing the number of leisure activities they partake in. There is also no one-sided shift in interacting with friends to interacting with relatives. Grandparenthood does not seem to restrict the social networks of grandparents to the family sphere.

1.7 Conclusion

This dissertation deals with productive activities in the context of grandparenthood and how they affect the health and well-being of grandparents. According to the long life span grandparents and grandchildren share with each other and the perceived importance of the grandparent role, I identified grandparental childcare as a central productive activity within the realm of the family. According to the successful and productive aging paradigm, I have also highlighted that the grandparental caregiver role might be one important role but is not the only important role grandparents take on in later life. With this in mind, I conducted three empirical

studies and considered role strain and role enhancement theory to link multiple-role occupation with health and well-being. Two of the three studies take a gender perspective.

The first and major contribution of this dissertation is that it reveals the methodological shortcomings of previous studies. A major part of the literature provided evidence that moderate levels of supplementary grandparental childcare lead to role enhancement and have positive outcomes. These studies do not sufficiently control for self-selection in regard to grandparental childcare and therefore interpret the positive correlation between grandparental childcare and health or well-being in a causal and misleading way. Appling a genuine within-person approach—fixed-effects panel models—all three studies in this dissertation adjust for the selection effects caused by time-constant covariates. Overall, such an analysis strategy reveals that the provision of grandchild care has no major influence on grandparents. This is in line with recent empirical studies with the SHARE data, which also apply fixed-effects models (Danielsbacka, Tanskanen, Coall & Jokela, 2019; Sheppard & Monden, 2019). The relevant literature as a whole is moving in this direction, which will likely lead to better evidence in the future. I am not suggesting that the fixed-effects approach is the only way to analyze the implications of productive activities; however, from my point of view and based on the findings in this dissertation, it is inevitable to address the selection mechanism that leads people into tackling productive activities. I want to point out that this is not only a technical argument but a theoretical one. The successful and productive aging paradigm argues that productive activities will not only benefit the environment (e.g., family or community) but individual health and well-being. Critical gerontology has pointed out that the perspective of structural inequality is not considered in this argumentation. A certain lifestyle, which describes the reality of the life of a certain privileged (selective) group in society, is normatively set as a universal goal for all. Thus, who is not able or willing to correspond to such a lifestyle is already conceptually neglected. A second contribution of this dissertation is the attempt to consider the underlying mechanisms of role strain and role enhancement. These concepts are often used to theoretically explain and validate empirical findings without explicitly considering the combination of different productive activities. Considering a gender perspective, the analyses suggested that grandparenting could have a negative effect on grandmothers' life satisfaction if it is not combined with other activities. Although the evidence is not clear, this emphasizes the central argument of this dissertation. Grandparenthood must not be considered in isolation from other important areas of life. Future research should take this into account more strongly, not only in theoretical discussions but also in empirical analyses. The third contribution of this

dissertation is that it broadens the view by two perspectives. First, I consider grandparenthood per se. Second, I expand the view from productive activities in a narrow sense to leisure activities in a wider sense. Again, no robust effects could be found. Grandparental childcare neither leads to a crowding in nor to a crowding out of leisure activities.

Despite these important contributions, the applied data and the empirical analyses suffer from several limitations, such as a) low number of within-person changes, b) attrition and sample selectivity, c) central variables being measured as single items, and d) the relatively long span between survey waves. These limitations—and some solutions to these issues—are discussed in greater detail in each study.

Promoting health and well-being in later life are important objectives in aging societies. Therefore, both professionals from civil society and policy makers often rely on active aging strategies. According to the successful and productive aging paradigm, they operate under the assumption that promoting productive activities will help tackle problems related to population aging. While being active and productive, people can contribute to family, economy, and society and promote health and well-being at the same time. Bearing this in mind, the World Health Organization developed a policy framework for active aging (WHO, 2002), and the European Union devoted the year 2012 to the year of promoting active ageing and developed an Active Ageing Index in order to enhance and use potentials of people in later life (Zaidi et al., 2018). Such strategies explicitly highlight the importance of activities like providing grandchild care, volunteering and informal care for disabled people/relatives. These general strategies have an impact on professionals at the micro level. In this context, in my graduate school GROW (Gerontological Research on Well-Being) we organized biannually meetings with practitioners outside the academia. In 2017, I presented in such a meeting to an audience of professionals working in the fields of social work and aging. I reported that against the expectation of a causality, the association between grandchild care and health might represent a selection into grandparental childcare. Some participants in the audience responded that such a finding would make their marketing strategy useless if productive activities are not accompanied with personal benefits. From my point of view, it is important that future research further investigate the questions of selection and causality in the context of grandchild care and further productive activities. At this point, research must also be more self-critical. In my opinion, there is widespread agreement, for example, about the seemingly positive influence volunteering has on health. However, associative correlations are interpreted far too

thoughtlessly as causal effects; consider for example the respective chapter in the Handbook of Sociology of Aging (O'Neil, Morrow-Howell & Wilson, 2011). In contrast, a meta-analysis that considers the research designs of the initial studies shows that the positive associations between volunteering and health indicated in observational studies are not confirmed by experimental investigations (randomized control trials) (Jenkinson et al., 2013). It is not only important that future research provides more clarity but social scientists are also responsible for communicating to policy makers and professionals in relevant fields that the causal mechanisms are not yet clear. Incorrect or insufficient understanding of scientific findings will otherwise lead to problems. It is not a question of stopping the promotion of engagement in productive activities; however, the causes are unclear and have not been verified. First, social policy measures are always accompanied by opportunity costs. Developing generic (one-size-fits-all) policy strategies under the assumption that productive activities promote health and well-being could lead to a lack of resources for more effective measures. Second, besides such strategies failing to promote health and well-being, they could additionally discriminate and harm those who are not willing or able to be productive in later life (Holstein, 2006; Kaskie, Imhof, Cavanaugh & Culp, 2008). Therefore, such approaches are not suitable as general strategies that are addressed to all aging population groups. In contrast to the generic approaches such as successful and productive aging, I therefore plead that the focus be placed on demand-oriented concepts for specific groups. For the group of grandparents, the analyses in this dissertation have shown that such an engagement is not associated with particularly positive or negative effects on health, life satisfaction, and leisure activities. Since grandparenthood and the relationship with grandchildren are important, policy makers can think about the measures needed to support and encourage intergenerational relationships within the family. However, this should not be done under the assumption that grandparenting contributes to increasing health or well-being for aging grandparents.

1.8 Status of the Studies and Contribution of Co-Authors

Chapter 2: *Does Grandchild Care Influence Grandparents' Self-Rated Health? Evidence from a Fixed-Effects Approach*, is single authored and published in Social Science & Medicine.

Chapter 3: *Gendered Productive Activities within and outside the Family: Implications for Grandparents' Life Satisfaction*, is single authored and submitted to Social Science Research.

Chapter 4: *Changes in Leisure Activities Before and After Grandparenthood*, is currently prepared for journal submission. I am the leading author and co-authors are Valeria Bordone (University of Vienna) and Bruno Arpino (University of Florence). All authors have developed together the research question. Merih Ates and Valeria Bordone worked on the theoretical part of the manuscript. Merih Ates prepared the data for analysis, conducted the analysis and drafted the manuscript. Valeria Bordone and Bruno Arpino contributed to the writing of the manuscript and commented on different versions of the manuscript. Bruno Arpino supervised the analysis.

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2 Does Grandchild Care Influence Grandparents' Self-Rated Health? Evidence From a Fixed-Effects Approach

Abstract

The present study aims to identify, whether and how supplementary grandchild care is causally related to grandparents' self-rated health (SRH). Based on longitudinal data drawn from the German Aging Survey (DEAS; 2008–2014), I compare the results of pooled OLS, pooled OLS with lagged dependant variables (POLS-LD), random and fixed-effects (RE, FE) panel regression. The results show that there is a positive but small association between supplementary grandchild care and SRH in POLS, POLS-LD, and RE models. However, the fixed-effects model shows that the intrapersonal change in grandchild care does not cause a change in grandparents' SRH. The FE findings indicate that supplementary grandchild care in Germany does not have a causal impact on grandparents' SRH, suggesting that models with between-variation components overestimate the influence of grandchild care on grandparents' health because they do not control for unobserved (time-constant) heterogeneity.

2.1 Introduction

Because of social changes in demography and family formation, intergenerational relationships (within and outside the family) are attracting increasing attention from both the public and academia. A relevant example of these relationships can be found in grandparent–grandchild relationships. Research shows that grandparenthood is rated as an important stage of life (Mahne & Motel-Klingebiel, 2012). Taking care of grandchildren is one special aspect of this relationship. As a result of medical and technical progress, grandparents remain active and healthy longer than in the past. Furthermore, the common lifespan between grandparents and grandchildren has increased (Lauterbach, 2002), even when the delay in grandparenthood (Leopold & Skopek, 2015) is taken into account. However, grandparents have become a significant resource by enhancing parents' job market participation, contributing to the integration of family and work life and supporting single parenthood (Brüderl & Ludwig, 2015), especially when the public childcare supply is insufficient. This phenomenon raises questions of whether and how caregiving activity affects grandparents' health and well-being.

Since the early 1990s, a growing body of literature has shed light on this question. To date, there is no clear evidence of the circumstances under which grandchild care promotes positive or negative effects on grandparents' health. One explanation is that a large part of the empirical literature is based on cross-sectional and small-scale data based on convenience samples (Grinstead, Leder, Jensen & Bond, 2003). Another reason is that there are a variety of grandchild care arrangements and cultural differences. To understand the link between provision of grandchild care and grandparents' health and well-being, it is crucial to distinguish between different care arrangements. The first distinction is between custodial care with primary responsibility and supplementary or occasional care. Especially in the United. States, the majority of studies focus on grandparents who raise their grandchildren. The high number of grandparents who actually provide such intensive and demanding care may drive this focus. According to the 2010 U.S. census, approximately 2.7 million grandparents have primary responsibility for at least one co-residing grandchild under 18 years of age (U.S. Census Bureau, 2014). Comparable data for Germany are not available. According to the 2011 German census, there are approximately 9,000 grandparent-grandchild (or grandparent¬¬–great–grandchild) households without co-residing parents (German Zensus, 2011). Although we cannot interpret this information as the frequency of custodial grandchild care, it illustrates that grandchild–grandparent care arrangements without the middle generation are not widespread in Germany.

In contrast, in 2008, 24.7% of the grandparents in Germany provided some supplementary care for their grandchildren. In 2014, the share of caregiving grandparents increased to 30.2% (Mahne & Klaus, 2017; Mahne & Motel-Klingebiel, 2012).

Only a few studies have investigated the relationship between supplementary grandchild care and various measures of health and well-being (Muller & Litwin, 2011). The evidence produced by these studies is mixed, as some measures are positively related to supplementary grandchild care, whereas others are not. With respect to self-rated health (SRH), studies have provided robust evidence that supplementary care is positively associated with grandparents' SRH (Di Gessa, Glaser & Tinker, 2016a; Hughes, Waite, LaPierre & Luo, 2007; Ku et al., 2013; Zhou, Mao, Lee & Chi, 2017). As previous findings on different health outcomes are already puzzling, there is sufficient reason to stay focused on SRH instead of providing new evidence for other measures of health, especially because previous studies remained unclear about the causal pathway between SRH and provision of supplementary grandchild care. Although these studies use panel data, they focus on a comparison between grandparents who provide grandchild care and those who do not. The present study aims to tackle this issue by applying panel data and comparing the results of models that consider between-unit variance (pooled OLS, POLS; pooled OLS with lagged dependant variables, POLS-LD), between- and within-unit variance (random-effects, RE) and within-unit variance (fixed-effects; FE).

The results show that similar to the existing literature, there is a significant but small association between supplementary grandchild care and SRH in the POLS, POLS-LD and RE models. In contrast, the FE model shows that the intra-personal change in grandchild care does not cause a significant change in grandparents' SRH. These findings indicate that neglecting unobserved (time-constant) heterogeneity could lead to overestimate the effect of grandchild care.

2.2 Theoretical Framework

Role theory has been applied in numerous studies to investigate the implications of caregiving on health. Two general remarks are therefore important. First, social roles constitute a link between the individual and society (Landry-Meyer, 1999). Second, salient roles affect health more strongly than less central roles do (Muller & Litwin, 2011). On the individual level, an overwhelming proportion of grandparents perceive their grandparent role as important or very important (Mahne & Motel-Klingebiel, 2012). There is also evidence suggesting a positive association between the quality of relationship with grandchildren and the subjective well-being

of grandparents (Mahne & Huxhold, 2015; Mahne & Motel-Klingebiel, 2012). As a social role, there is also a normative expectation of grandparents that becomes even stronger in ageing societies (Kivnick, 1983; Muller & Litwin, 2011; Neuberger & Haberkern, 2014). This highlights the meaning of grandparents' role on the micro and macro level.

For the primary care responsibility in particular, the time-disordered role approach assumes a negative impact of raising a grandchild on grandparents' health and well-being. It assumes that the timing of roles is associated with a sense of fit. Grandparents' expectations regarding their role differ from the parental obligations of raising a child. Grandparents may be looking forward to experiencing the empty-nest stage, and a violation of this life expectation may cause stress and isolation from their age peers who are experiencing different life circumstances (Jendrek, 1993; Landry-Meyer, 1999). Therefore, an adverse health effect seems plausible, which is also supported by the role strain approach. Demanding roles cause psychological and physical stress, especially if a person faces multiple role expectations. Raising and caring for a grandchild is a time-consuming challenge, and from a role strain perspective, it may compete with other roles, such as parenting or working (Di Gessa, Glaser & Tinker, 2016a; Szinovacz & Davey, 2006). Frequent studies embed role strain theory into a wider theory of stress (Grinstead, Leder, Jensen & Bond, 2003). Role strain represents one aspect of secondary stressors that cause adverse physical health, depression, or anxiety. Coping strategies and social support can buffer these negative effects (Pearlin, Mullan, Semple & Skaff, 1990). In contrast to role strain, role enhancement does not focus on conflicts that emerge from multiple roles but on the benefits of a "multifaced self" (Szinovacz & Davey, 2006). This approach assumes that productive roles help to promote personal identity and self-expression. Furthermore, they provide "important resources such as social support, which can reduce stress outcomes or enhance their role" (Zhou, Mao, Lee & Chi, 2017). Therefore, in contrast to other roles, being a grandparent caregiver can be positively associated with health.

2.3 Grandchild Care and Associations With Health: Previous Empirical Findings

2.3.1 Primary Responsibility and Custodial Care

Custodial grandchild care can increase grandparents' self-esteem and purpose and may be perceived as satisfying (Jendrek, 1993; Pruchno, 1999; Pruchno & McKenney, 2002). However, studies have tended to highlight negative associations (Kelley, Whitley, Sipe &

Crofts Yorker, 2000; Musil et al., 2009; Sands & Goldberg-Glen, 2000). Hayslip and Kaminski (2005) concluded in a literature review that custodial care is associated with poor physical and mental health, role overload, role confusion, and isolation from age peers and noncustodial grandchildren. In contrast, a more recent study does not find substantial consequences of custodial grandchild care (Trail Ross, Kang & Cron, 2015). However, longitudinal analyses show that negative impacts on health appear only for grandparents who raise their grandchildren in skipped-generation households (Blustein, Chan & Guanais, 2004; Hughes, Waite, LaPierre & Luo, 2007; Musil et al., 2011; Musil et al., 2013). These effects of care arrangement are embedded in a cultural context. In the United States, multigenerational or skipped-generation households and grandparental involvement in grandchild care are most likely the result of family dysfunction (Baker & Silverstein, 2008; Hayslip & Kaminski, 2005; Minkler, Roe & Price, 1992; Trail Ross, Kang & Cron, 2015). In contrast, co-residing with children and/or grandchildren is a common phenomenon in Chinese culture. Given this, grandparents living in multigenerational and even skipped-generation households report better psychological well-being than grandparents who live in single-generation households (Silverstein, Cong & Li, 2006).

2.3.2 Supplementary and Occasional Grandchild Care

Although only a small part of the relevant literature focuses on supplementary care, it is not easy to provide an overview for two main reasons. First, different studies have compared different caregiving groups, such as comparing supplementary caregivers with noncaregivers or with primary caregivers (Musil et al., 2013). Second, different outcomes have been considered, such as SRH, physical limitations, life satisfaction, depressive symptoms, or cognitive functioning. Evidence is mixed: Some researchers have reported a positive association with supplementary care, whereas others have reported a nonsignificant relationship (Hughes, Waite, LaPierre & Luo, 2007; Zhou, Mao, Lee & Chi, 2017), or a negative association with depressive symptoms (Brunello & Rocco, 2019).

SRH is one widely established and popular measure of health in large-scale health surveys (Jylhä, 2010; Layes, Asada & Kepart, 2012). Although there are controversial debates over whether SRH captures objective health or subjective perception of health (Layes, Asada & Kepart, 2012), there is evidence that SRH both reflects physical and mental measures of health (Singh-Manoux et al., 2006) and predicts mortality (Idler & Benyamini, 1997; Jylhä, 2009).

With respect to SRH, the existing literature for supplementary care is less contradictory and consistently reports a positive association. The most recent studies in this area are longitudinal and based on large-scale data. Using data the U.S. Health and Retirement Study, Hughes et al. (2007) compared the SRH of grandparents who recently started, continued, or stopped grandchild care with their noncaregiving counterparts. When relevant covariates and prior health (due to reverse causality) are controlled, grandmothers who started, and continued giving care reported better SRH two years later than grandmothers who did not provide any care. The grandchild care coefficient on grandfathers' SRH was not significant. According to this study, there is no association for grandfathers. In China, repeated and previous caregivers experienced better SRH than noncaregiving grandparents did. This relationship was partly mediated by emotional support. Repeated caregivers tended to report poorer SRH if they received less emotional support from their children (Zhou, Mao, Lee & Chi, 2017). In another study of data from Taiwan, the authors differentiated between long-term and recent caregiving grandparents who did not co-reside with their grandchildren. The authors again controlled for health at baseline and showed that compared to grandparents who did not provide any care, long-term caregivers were more likely to report better SRH. Recently started caregivers did not differ significantly from noncaregivers (Ku et al., 2013). Di Gessa et al. (2015) applied four waves of SHARE and distinguished between intensive and nonintensive care. Controlling for baseline SRH and related covariates, intensive childcare was positively associated with SRH two years later. Four years later, the effect was no longer significant. In contrast, nonintensive childcare was positively associated with SRH only after a four-year follow-up. Compared to grandparents who repeatedly provided nonintensive care in two waves, grandparents were more likely to face poor SRH if they did not provide any care during the same interval (Di Gessa et al., 2015). In a second study, Di Gessa et al. (2016b) provided evidence, albeit only for grandmothers, that intensive and nonintensive childcare has a positive effect on health (applying a latent health measure by combining several indicators), even after early adulthood and childhood conditions, baseline health, and socio-economic characteristics are taken into account.

2.3.3 Methodological Issues With Previous

Drawing causal inferences with survey data is quite challenging. There are different possibilities to misspecify (Andreß, Golsch & Schmidt, 2013: 98) regression models, such as selective samples or measurement errors. One possible specification error is addressed in the so-called exogeneity assumption that applies to all kind of regression models. Exogeneity

means the error term v_{it} is independent of all covariates in the model. Otherwise, model estimates will be inconsistent and biased (endogeneity problem). Two major patterns can cause problems with endogeneity: unobserved heterogeneity and reverse causality. Unobserved heterogeneity is also known as the omitted variable bias (Andreß, Golsch & Schmidt, 2013). An omitted control variable can cause a selection into treatment and therefore lead to a biased estimation. For example, retired grandparents might be more likely to provide care and, furthermore, retired grandparents might differ in their health status from nonretired grandparents. A significant association between grandchild care and SRH might only be spurious if the model does not control for retirement status. Reverse causality concerns the direction of an association. Does a change in treatment cause a change in the outcome or the other way around, or are treatment and outcome even simultaneously influencing each other? In the present case, for example, grandparents with better health might be more likely to provide grandchild care (Hank & Buber, 2009). Only longitudinal analyses or other methods established as causal models like instrumental variables (IVs) can fix such endogeneity problems. Therefore, the previous chapter discussed only studies that apply longitudinal data to examine whether or not stability and change of supplementary grandchild care influence grandparents' SRH. These studies estimate lagged dependant (LD) variables (equation 1) and conclude that especially stable care over time is positively associated with SRH. However, the design of these LD models is problematic in two ways. First, they only address the problem of reverse causality. Second, they not only neglect issues of unobserved heterogeneity but lead precisely to this problem:

$$y_{it} = \rho y_{i,t-1} + x'_{it}\beta + z'_i\beta + v_{it}. \quad (1)$$

In equation (1), y_{it} denotes the outcome variable for individual i at time t, whereas ρ is the lagged value of the outcome for person i at time t-1. The vectors x'_{it} and z'_i represent sets of time-varying and time-constant control variables, respectively. The error term is denoted by v_{it}. The error term v_{it} and the LD variable $y_{i,t-1}$ are statistically not independent; therefore, the exogeneity assumption is violated and model estimates are biased (Brüderl & Ludwig, 2015). Furthermore, all mentioned studies follow a between-comparison approach. They compare the SRH of noncaregiving grandparents with that of caregiving grandparents. In the Analysis strategy chapter I will explain why a between-unit comparison will most often lead to a certain type of unobserved heterogeneity (time-constant) and why a within-unit-comparison

(the same person serves as his or her own comparison over time) can provide a solution for this problem.

As already reported, previous studies with a lagged-dependent design (adjusting for reverse causality) found a positive association between supplementary grandchild care and SRH. However, the following studies apply FE models and show that rather a bias caused by unobserved heterogeneity may be an issue identifying whether or not the association between care and subjective health is driven by causation or selection. To my knowledge, only three research articles report results from FE models in terms of supplementary care. In one paper Ku et al. (2012) compared POLS, FE, and FE-IV models to investigate the relationship between provision of grandchild care and grandparents' health. In terms of SRH, they reported a positive coefficient in the POLS model. The FE coefficient was much smaller in magnitude, but still significant. The corresponding coefficient was not significant in the FE-IV model. However, based on their specification test (test of exclusion restrictions, and test of endogeneity), the authors claimed that the FE model is the preferred model in terms of SRH. However, this finding is not applicable to supplementary care, because it does not distinguish the effect of caregiving by co-residence status. In their lagged-dependent design, Ku et al. (2013) found a significantly better SRH for nonresidential grandchild caregivers ("babysitting") compared to noncaregivers. At least in their robustness check, they reported that this effect "attenuated and lost statistical significance in the fixed-effects models" (Ku et al., 2013: 1019).

These two studies referred to Taiwan, a different cultural context. Therefore, it is important to apply FE models with different data from different cultural contexts to gain knowledge on the present topic. Reinkowski (2013) applied SHARE data to investigate the relationship between supplementary care and grandparents' health. Based on OLS, LD, and treatment (propensity score matching) models, she also reported a significant positive association. However, the FE and IV models showed no significant association. Cognitive functioning and physical and mental health were used as outcome variables. SRH, which is an overall measure of health and which is of particular interest in this paper, was not considered (Reinkowski, 2013).

These findings suggest a positive selection effect due to unobserved heterogeneity. However, there is an ongoing debate in the literature on the causal relationship between provision of grandchild care and grandparents' health; therefore, it is necessary to provide more evidence than that provided by the only three studies that consider within variation. The present study is

linked to these studies with the aim of contributing empirical evidence to the ongoing and controversial discussion in the literature.

2.4 Research Design

2.4.1 Data and Sample

The analysis uses data from the German Aging Survey (DEAS), which is an ongoing and nationwide representative survey. The target group is the German population aged 40 and older (Engstler & Schmiade, 2013). The current analysis uses the 2008 sample and its panel structure. Prior waves are not applicable because information on grandchildren, especially age, has only been measured since 2008. The DEAS baseline sample 2008 contains n = 6,250 observations, n = 2,858 follow-up observations in 2011, and n = 2,569 follow-up observations in 2014. Out of this sample, I excluded participants who had no grandchildren, either in 2008, 2011 or 2014. In addition, participants were excluded because their youngest grandchild was older than 15 years in 2008. Please note that this information refers to the youngest grandchild of the observed grandparent, which is not necessarily the grandchild who receives care. Furthermore, I excluded participants who exclusively provided care for nongrandchildren (e.g., children of siblings or neighbors). The dataset now includes n = 2,197 observations in 2008, n = 1,049 observations in 2001, and n = 909 observations in 2014. Out of this, I retained only those participants who participated in all three waves (strongly balanced panel) and who provided information on all variables included in the regression models (no missing values). The final sample contains 625 participants surveyed in all three wave (n = 1,875 person*years observations.

2.4.2 Measure

The DEAS uses the following item to measure childcare activity: “I’d now like to go on to learn more about your activities and pastimes. Do you look after or supervise other people’s children privately, e.g., your grandchildren or the children of siblings, neighbors, friends, or acquaintances?” Participants could give multiple answers for each category. The value 0 indicates “no care,” and the value 1 indicates “care.” Grandparents who provide care for their grandchildren and for other children remain in the sample. I excluded all participants who only provided care for other children but not for their grandchildren. Prior research has highlighted that stable care over time is especially relevant in terms of health. Therefore, I introduced a dynamic counter variable of grandchild care that increases with each additional wave of care

provided. To clarify, if a person provided care in all three waves, then grandchild care appears as 1 in 2008, as 2 in 2011, and as 3 in 2014. If a person provides care only in 2011, then grandchild care appears as 0 in 2008, as 1 in 2011, and as 1 in 2014. Grandparents who did not provide care at all will always appear with the value 0. This operationalization of grandchild care enabled me to apply both stability and change of care over time and to estimate an appropriate grandchild care effect in the fixed-effects model. Applying the original grandchild care dummy would lead to a biased estimation of the grandchild care effect. The FE estimator cannot estimate time-constant effects. Thus, the model would not differentiate between grandparents who provided care continuously over all three waves and those who did not provide any care at all. Considering high and low levels of care is not applicable because of the small sample size, especially for long-term caregivers.

Self-rated health is measured as a single item coded from 1 (very bad) to 5 (very good). Although this measure of the outcome is an ordinal variable, both models treat SRH as a metric variable. Research has shown that this common procedure (Brüderl & Ludwig, 2015) does not yield substantially different results compared to models that consider the ordered structure of the outcome variable (Ferrer-i-Carbonell & Frijters, 2004).

Control variables are the number of grandchildren, relationship quality with family, partnership status, retirement status, volunteering, body mass index and demographics such as gender, age, education, and income. A time trend variable is also included in all models. Partnership status is represented by a dummy variable, which appears as 0 if the person is not in an intimate relationship and as 1 otherwise. The relationship is not differentiated by legal status or co-residence. Retirement status is operationalized as 0 for "not retired" and as 1 for "retired." The nonretired group is not differentiated by employment status. The volunteer variable takes the value 1 if people voluntarily work in groups or organizations and 0 if they do not. Body mass index is categorized as "under- and normal weight" (BMI < 25), "overweight" (BMI 25–29.9), or "obese" (BMI 30+). Age is categorized as "40–49 years," "50–59 years," "60–69 years," "70–79 years," or "80+ years". The ISCED-scale is applied to divide participants into low (ISCED 0-2), medium (ISCED 3-4) and high (ISCED 5-6) levels of education. I used the logarithmized monthly net household income in Euro (new OECD equivalence scale).

2.4.3 Analytical Strategy

Panel data are a specific form of multilevel data (e.g., individuals nested in families) representing repeated observations of individuals over time. Nested data allow decomposing the error term v_{it} into the unit-specific error u_i and the idiosyncratic-error term ε_{it}.

$$y_{it} = x_{it}\beta + v_{it};\ v_{it} = u_i + \varepsilon_{it} \quad (2)$$

The ε_{it} varies across individuals and over time. The u_i denotes unobserved stable (time-constant) characteristics of a person. Examples are genes or personality, which are most often not observed in social science data. Therefore, the time-constant error term u_i captures unobserved (time-constant) heterogeneity. As already stated, regression models are only unbiased under the exogeneity assumption. This requires that the unobserved (time-constant) heterogeneity is exogenous E($x_{it}\ u_i$) = 0 and the idiosyncratic-error is contemporaneously exogenous E($x_{it}\ \varepsilon_{it}$) = 0. The second condition is considered a reasonable assumption. However, the unobserved (time-constant) heterogeneity condition is usually unreasonable (Brüderl & Ludwig, 2015: 328) because no model can control for all relevant covariates, especially if the corresponding measures are missing from the data. The POLS model ignores this issue; it simply assumes there is no unobserved (time-constant) heterogeneity. The error term v_{it} composes both error components. The exogeneity assumption is usually violated, and the estimates are biased (Brüderl & Ludwig, 2015). The FE model extends the exogeneity assumption into the strict exogeneity assumption. This extension requires that the idiosyncratic error and the covariates are independent of each other not only in their contemporaneous values but also in their past and future values. However, the advantage of FE concerns the handling of the unobserved (time-constant) error u_i.

$$(y_{it} - \bar{y}_i) = (x_{it} - \bar{x}_i)'\beta + (\varepsilon_{it} - \bar{\varepsilon}_i) \quad (3)$$

FE transforms the data (demeaning process) before applying a POLS regression. That means that FE only extracts the within-variation of subjects over time. Between-unit variation (person-specific means) will not be considered in the regression model. Therefore, the unobserved heterogeneity error is completely eliminated (Brüderl & Ludwig, 2015). Thus, FE coefficients are also called within-unit estimates as they identify person-specific changes over time. In contrast, POLS is considered as between-unit estimation, because coefficients only capture differences between units. The RE model is placed between the POLS and FE approach. Similar

to FE, it decomposes the error term v_{it} by transforming the data before running a POLS regression. However, the RE transformation process includes between-unit and within-unit variation (a partially demeaning process; for further information see Wooldridge, (2009)). Therefore, a part of the unobserved error remains in the equation. RE assumes that the remainder of unobserved heterogeneity is independent of the covariates in the model. Only in this case will RE be unbiased and consistent. Again, very often this assumption does not hold in social science data (Andreß, Golsch & Schmidt, 2013).

To summarize, models that apply between-unit variation (POLS, RE) are not considered as causal models because usually they do not appropriately deal with unobserved (time constant) heterogeneity. This can cause a selection into treatment, and therefore regression estimates will be biased. FE eliminates the unobserved (time-constant) heterogeneity and applies only within variation. Therefore, FE identifies a causal effect if the within variation is exogenous. In addition to selection bias due to unobserved (time-constant) heterogeneity, I discussed a second source of endogeneity: reverse causality. In this case, the within-unit variation is not exogenous, and FE will fail to estimate a causal effect. Although we should be aware of reverse causality in the current analysis, the discussion of the previous literature suggested that unobserved (time-constant) heterogeneity rather than reverse causality may be a serious issue that might lead to biased findings. Ku et al. (2013) and Reinkowski (2013) showed that FE models do indeed yield to different results. Ku et al. (2012) tested the FE model against the FE-IV model. In terms of SRH health, they decided that the exogeneity assumption holds and that FE is the preferred model. Therefore, I argue that the exogeneity condition holds for the present analysis and that it is appropriate to proceed with FE. Therefore, the strength of this paper is that the FE approach focuses on the unobserved (time-constant) heterogeneity problem and comes one step closer to a causal conclusion than lagged dependent models do.

2.5 Empirical Findings

2.5.1 Descriptive Statistics

Table 1 shows descriptive statistics separated by sample wave. In 2008, approximately 33.3 % of the sample provided grandchild care. This proportion remained stable in 2011 (32.2%) and 2014 (32.2%). Similar patterns are visible for volunteering and SRH. The share of participants who volunteered remained stable over all waves with approximately 21%. On average, in 2008

grandparents rated their SRH as 3.6 on a 5-point Likert scale. Although one would expect health to decline during the ageing process, SRH remains essentially stable over time. This pattern may be caused by selective panel attrition. It seems that more active and healthier grandparents tend to stay in the panel.

Table 2 Sample Characteristics by panel wave

Variables	**2008**	**2011**	**2014**
SRH (mean)	3.61	3.55	3.49
Grandchild care (ref. no grandchild care)	33.28	32.16	32.16
Social Relationships			
Number of grandchildren (mean)	3.16	3.51	3.67
Relationship quality: family (mean)	4.14	4.14	4.06
Partnership Status (ref. no intimate partner)	85.28	84.48	81.60
Productive Activities			
Volunteering (ref. not volunteering)	21.44	21.28	21.44
Retirement (ref. not retired)	63.84	72.80	80.48
BMI			
Underweight and Normal weight	32.80	33.76	31.52
Overweight	44.16	41.28	44.32
Obese	23.04	24.96	24.16
Demographics			
Female (ref. male)	48.32	48.32	48.32
Education			
Low	6.56	6.56	6.56
Medium	67.84	67.84	67.84
High	25.60	25.60	25.60
Age in years			
40 – 49	4.80	1.28	0.16
50 – 59	21.44	15.84	11.04
60 – 69	40.64	33.44	28.96
70 – 79	30.08	42.40	46.88
80 +	3.04	7.04	12.96
N	625	625	625

Figure 1 provides information on stability and change in grandchild care (counter variable explained previously) over all waves. In 2008, 417 grandparents did not provide grandchild care. Among them, 328 grandparents in 2011 and 282 grandparents in 2014 still did not provide any care. In 2011, 185 grandparents either started or stopped providing care, and 112 grandparents provided care in 2008 and 2011. In 2014, 137 grandparents provided care for two waves, and 65 grandparents continuously provided care in all three waves. When viewing the regression analyses and the interpretation of the coefficients, it is important to note that the variation for SRH and grandchild care is mainly driven by between-unit variance. However, there is also sufficient within variance to justify a FE model (Table 2).

Figure 1: Stability and Change in Care Over all Waves (Frequencies & Percentage)

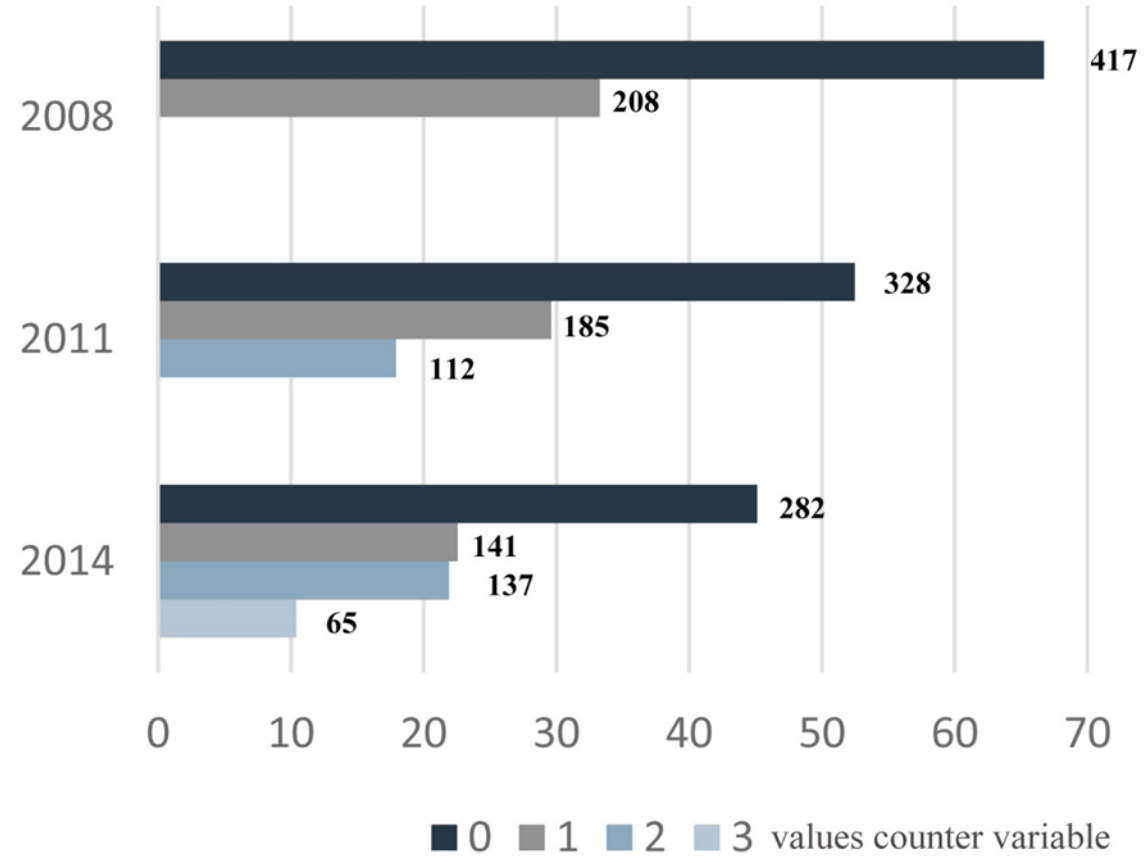

Table 2: Variance Composition for SRH and Care

Variables		*Range*	*Mean*	*SD*
Self-Rated Health (SRH)		1-5	3.55	
	overall			0.78
	between			0.63
	within			0.46
Grandchild Care		1-3	0.65	
	overall			0.84
	between			0.72
	within			0.43

2.5.2 Multiple Regression Results

Table 3 shows the POLS, POLS-LD and RE regression results. The POLS and POLS-LD models were estimated with robust standard errors. Overall, we can see similar results for the association between grandchild care and SRH between all models. The POLS regression shows that there is a positive and significant association between supplementary grandchild care and SRH. Controlling for the previous value of SRH, we can see in the POLS-LD model that the care coefficient decreases slightly but is still significant. As expected, there is also a significant and positive association between grandchild care and SRH in the RE model. Although the RE model considers the panel structure of the data, the estimations are not consistent if unobserved (time-constant) heterogeneity is present. The corresponding Hausman test does not reject the H0 hypothesis that the differences between random and fixed-effect coefficients are not systematic [$Chi^2(15) = 51.27$, $p = 0.000$]. Thus, FE is the consistent model because it controls for unobserved (time constant) heterogeneity. In contrast to models with between-variance components, the FE model shows that an intrapersonal change in grandchild care does not cause a change in grandparents' SRH. The corresponding coefficient is not significant (Table 4).

Table 3: Regression Results: pooled OLS, pooled OLS-LD ("lagged-dependant"), and Random-Effects (RE) Models

	Self-Rated Health (SRH)					
	pooled OLS		**pooled OLS-LD**		**RE**	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Grandchild Care	0.06*	(0.03)	0.04*	(0.02)	0.07**	(0.02)
SRH (lagged)			0.44***	(0.03)		
Intercept	1.17**	(0.37)	0.40	(0.34)	1.30***	(0.35)
R^2 (overall)	0.121		0.302		0.116	
Observations (person*year)	1,875		1,250		1,875	
Individuals					625	

Notes: Regression coefficients are unstandardized and unweighted; POLS and POLS-LD models are estimated with clustered standard errors at the individual level;
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 4: Regression Results: Fixed-Effects (FE) Models

	Self-Rated Health (SRH)	
	Coef.	S.E.
Grandchild care	0.05	(0.04)
Social Relationships		
Number of grandchildren	0.03	(0.02)
Relationship quality: family	0.04	(0.03)
Partnership Status	-0.04	(0.09)
Productive Activities		
Retirement (ref. not retired)	0.12^{+}	(0.07)
Volunteering	0.10^{+}	(0.06)
BMI		
Underweight and Normal weight	-	
Overweight	0.12	(0.07)
Obese	0.20*	(0.10)
Demographics		
HH Income (ln)	0.20**	(0.07)
Age in years		
40 – 49	0.24^{+}	(0.13)
50 – 59 (ref.)	-	
60 – 69	-0.009	(0.08)
70 – 79	-0.09	(0.11)
80 +	-0.10	(0.15)
Time trend		
2008	-	
2011	-0.09*	(0.04)
2014	-0.17***	(0.05)
Intercept	1.74***	(0.51)
Observations (person*year)	1,875	
Individuals	625	
R^2: within	0.038	

Notes: Regression coefficients are unstandardized and unweighted;
+ p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001.

2.6 Discussion

Grandparenthood matters, especially in an ageing population with an increasing life expectancy. Grandparents can function as an important resource for their offspring. In particular, grandchild care is one opportunity for such an intergenerational support. The present investigation addressed two objectives: first, to advance our knowledge on the causal relationship between grandchild care and grandparents' health, and second, to discuss methodological issues in the previous literature and thereby, to improve empirical analyses on this topic. The analysis is based on the question of whether the positive association between

grandchild care and grandparents' SRH, which has been repeatedly observed in previous studies, represents a causal effect from grandchild care on SRH or whether the association reflects a selection effect caused by unobserved (time-constant) heterogeneity. Comparable to the existing literature, the results of models with a between-unit variance suggest a positive association between provision of stable grandchild care over time and grandparents' subjective health (Di Gessa, Glaser & Tinker, 2016a; Hughes, Waite, LaPierre & Luo, 2007; Ku et al., 2013). The estimates of grandchild care in the FE model are not significant. These findings are in line with Ku et al. (2013) and Reinkowski (2013). The null effect in the FE model could indicate two issues. First, reverse causality may not be a determining factor. Otherwise, if subjective health influenced the propensity of grandchild care provision, the corresponding FE estimation might appear as significant. Second, healthier grandparents may be selected into grandchild care due to unobserved (time-constant) heterogeneity, and this is probably why the grandchild care effects appeared significant in the POLS, POLS-LD, and RE models. Ku et al. (2012) draw the same conclusion. However, the differences in the effect size between all estimated models are very small, and conclusions should be drawn very carefully. Even so, the present paper makes an important contribution to the literature. The FE model did not provide any evidence for a significant relationship between the provision of grandchild care and SRH. One would draw an opposing conclusion if the analyses would only consider lagged depended panel models, which is far more common in the existing literature. Therefore, previous findings based on lagged dependant models should be evaluated very critically.

Before discussing potential methodical limitations of the present study, I want to address some theoretical considerations. The current analysis and the relevant literature refer to role strain and role enhancement theory to explain the link between supplementary grandchild care and grandparents' health. With regard to these approaches, little research has been conducted on the interaction between grandchild care and other role occupations, such as volunteering or providing informal care for one's own parents or parents-in-law. Szinovacz & Davey (2006) can show that grandmothers who provide intensive grandchild care experience an increase in depressive symptoms if they are retired. This finding agrees with role enhancement; the authors argue that employment may buffer care-related stress. For a better understanding of role strain and role enhancement in the context of supplementary grandchild care, further research must focus on the interaction of grandchild care and other age- and gender-related roles occupied by grandparents.

The interpretation of the described and discussed results should consider that the analyses have some limitations. Longitudinal studies on grandchild care that apply data from sources such as the U.S. Health and Retirement Study (HRS) or the Survey of Health, Aging and Retirement in Europe (SHARE) face the problem that the time span between applied panel waves is relatively long. The same problem occurs with DEAS data, as there is a three-year time span between panel waves. Therefore, we should be aware that we have no information on grandparents' behaviour between these three years. A second limitation concerns that the analysis only includes three panel waves and this could limit the within variation in the model. This may explain why the fixed-effects coefficients were not significant. However, the descriptive statistics confirmed that the data included an adequate amount of within-unit variance. A third limitation may concern that the analysis does not differentiate between non-co-residing and co-residing care arrangements. However, official statistics acknowledge that this is negligible in Germany, which had about 9,000 skipped-generation households in 2011 and about 221,000 (0.6% of all German households) multigenerational households in 2008 (Destatis, 2016; Germen Zensus, 2011).

To conclude, from both a theoretical and methodological perspective, we need more research to understand the link and the underlying mechanisms between supplementary grandchild care and grandparents' health and well-being. Lastly, it is important to note that panel attrition is a serious problem of panel data and DEAS selectivity analyses indeed show that healthier participants exhibit a greater propensity to participate in the follow-up surveys. This might bias the results of the regression analyses.

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3 Gendered Productive Activities within and outside the Family: Implications for Grandparents' Life Satisfaction

Abstract

This study examines how combining grandchild care and other productive activities influences grandparents' life satisfaction. Although authors of previous studies discusses role strain and role enhancement as possible mechanisms, the implications of grandchild care when combined with other productive activities is largely neglected. To consider gendered activity patterns, I distinguish between activities carried out within the family (grandchild care and informal care) and outside the family (formal volunteering). To adjust for selection effects, I apply longitudinal data from the German Ageing Survey (1996–2014) and estimate fixed-effects panel models. Grandchild care does not influence grandfathers' life satisfaction, regardless of whether combined with other activities. Cautiously formulated, the results indicate that grandchild care may have a negative effect on grandmothers' life satisfaction when not combined with other activities. This effect vanishes if grandmothers combine grandchild care with informal care and volunteering. However, I only observe this negative effect in a subsample of those participants who were observed in 1996 for the first time. More research is needed to verify these findings.

3.1 Introduction

In Western societies, grandparents and grandchildren share more than two decades of overlapping lifetimes (Leopold & Skopek, 2015a; Leopold & Skopek, 2015b). This phenomenon has stimulated a great body of scientific research on grandparenthood. Aspects investigated in the literature include grandparents' sociodemographic characteristics, intergenerational relationships within the family, and the attitudinal aspects of the grandparent role (Hank, Cavrini, Di Gessa & Tomassini, 2018). One major strand of research is focusing on behavioral aspects of grandparenthood and especially on the provision of grandchild care. Due to increasing longevity and healthy life years, we need to consider that grandparenthood overlaps with further important aspects in life (Muller & Litwin, 2011). A variety of opportunities may therefore present positive and negative implications. Social expectations to remain productive within and outside the family–household sphere can lead to a grandparenthood reconciliation problem similar to problems encountered in parenthood.

A dominant narrative in aging research that has evolved since the 1980s is the productivity narrative. Within this narrative, various concepts, such as successful (Rowe & Kahn, 1997), productive (Morrow-Howell, Hinterlong & Sherraden, 2001), and active aging (Foster & Walker, 2015) have developed. These approaches argue that engaging in productive activities maintains functional capacities and promotes health and well-being in later life. This paradigm is not just a scientific concept used to describe and analyze aging. It also includes normative aspects of how people should behave—that is, be productive—to age well. Through this narrative, promoting productive engagement has become a major and global policy strategy (WHO, 2002). Critical gerontologists have demonstrated that an exaggerated productivity norm might discriminate against individuals who are unable to meet this norm (Holstein, 2006; Kaskie, Imhof, Cavanaugh & Culp, 2008). In fact, gerontology as a science has itself contributed to the emergence and dissemination of such a productivity narrative (Martinson & Minkler, 2006).

Even if no common definition of productive activities exists, apart from occupational work, formal (i.e., organization based) volunteering in civil society is emphasized above all else (Martinson & Minkler, 2006). Glaser and Hank (2018) claim to widen the perspective: "Considering its considerable (economic and non-economic) societal value, it is indeed important to include productive ageing activities within families (such as the provision of

childcare) in assessments of older people's active engagement in society, which often tends to be limited to 'public' activities (e.g. volunteering; . . .)" (Glaser & Hank, 2018: 221).

Given this background, I investigate whether the combination of various productive activities within and outside the family sphere affects grandparents' life satisfaction. Therefore, I consider the interplay of grandchild care with formal volunteering and informal care.

In addition to the emotional dimension (positive and negative affect), subjective well-being includes a cognitive dimension represented by life satisfaction (Diener, 2000). This includes personal goals and an overall evaluation of one's life. Life satisfaction is therefore especially suited to answering these research question because I am interested in evaluating whether grandmothers and grandfathers are content with their activity arrangements without measuring that directly. Thus, I link actual behavior with overall life evaluation.

My rationale for linking combinations of productive activities with life satisfaction is based on multiple-role occupation (role strain vs. role enhancement theory). Existing research has shown that social roles are especially important to life satisfaction if they are perceived as socially important (Neuberger & Haberkern, 2014). Gender plays a fundamental role in this relationship. I argue that not only the provision of productive activities, but also social expectations about these activities, are gendered. Therefore, the implications for life satisfaction may also be gendered.

This paper contributes to the existing literature in three ways. First, although many studies address role strain and role enhancement theory conceptually, almost none consider the combination of activities and their gendered structure empirically. For example, the impact of grandparenting on life satisfaction might depend on grandparents' volunteering engagement and gender. Thus, I connect the largely separate grandparenting literature and productive activity literature. I found only two studies investigating the consequences of grandchild care in combination with other productive activities: Baker & Silverstein (2008) and Szinovacz & Davey (2006). Although both studies use longitudinal data, they apply cross-sectional analyze techniques by estimating lagged dependent models, which are considered to generate biased estimates (Ates, 2017; Brüderl & Ludwig, 2015). Furthermore, Baker & Silverstein (2008) do not differentiate between grandparents' gender and the gendered structure of productive activities. Second, the empirical research on grandchild care also neglects perspectives from critical gerontology regarding the productivity narrative, which I address. Third, I apply

longitudinal data and estimate regression analyses that consider only within-person changes (fixed-effects panel estimator) to control for selection into grandchild care and productive activities caused by time-invariant heterogeneity. Such an empirical approach is scarce in this field, but is essential to approaching causality (Ates, 2017). For the analysis, I will use the German Aging Survey (DEAS). Germany is a suitable case for this study, because among European countries, it is an average case for the degree of intergenerational support (Hank & Buber, 2009) and the proportion of productive activities (Hank & Stuck, 2008).

3.2 Background

3.2.1 Multiple Role Occupation

Concerning the association between grandchild care and well-being, role theory—role strain and role enhancement theory in particular—is the most common approach applied in the literature. According to role strain theory (Goode, 1960), grandchild care might constitute additional stress and burdens; therefore, its connection to life satisfaction might be negative. In contrast, role enhancement (Sieber, 1974) focuses on the benefits of a multiple role identities; therefore, a positive association may exist between the provision of grandchild care and life satisfaction. However, these approaches involve two shortcomings. First, the approaches treat the relationship between the number of activities and life satisfaction as linear and additive. The more activities, the stronger the expected effect, like it is conceptualized by Baker, Cahalin, Gerst & Burr (2005) and Baker & Silverstein (2008). I do not question the basic premises of role strain and role enhancement—that the accumulation of activities matters—but I doubt that this is a sufficient way to investigate the consequences of role accumulation, as different types of activities and their combinations may lead to different results. Second, neither role strain nor role enhancement addresses gender-specific considerations.

3.2.2 Gendered Structure of Productive Activities

Social structure is designed such that some groups are systematically privileged and others are disadvantaged (Connidis & McMullin, 2002; Estes, 2001). Next to class, age or ethnicity, gender is a key dimension of structural inequality. The gender-differentiated division of labor plays an important role in this: ". . . because of their position in the social structure, women are both expected to and do provide more of the caring required of family members and,

consequently, their experience of ambivalence will vary from that of men" (Connidis & McMullin, 2002: 561).

In this regard, it is important to distinguish between two productive activity types based on their gendered structure. The first type includes informal activities performed within the family and household context (e.g., domestic work or informal care), which are traditionally associated with a female caregiver role model. I consider grandchild care a productive activity that follows this tradition. The second type includes formal activities performed in a public, nonfamily context (e.g., [full-time] employment, formal volunteering, or involvement in political parties), which are traditionally associated with a male breadwinner role model. Against this background, I follow Holstein's (2006) argument that working or volunteering and providing care for grandchildren or relatives with needs follow different gendered logics. Holstein argues that the productivity narrative addresses public, traditionally masculine activities

The empirical evidence confirms the theoretical discussion of the gendered division of labor. Women in the second half of life take up the majority of grandchild care, domestic work, and informal care. They frequently accumulate these responsibilities even if they participate in the labor market (Mahne, Wolff, Simonson & Tesch-Römer, 2017). Research on women also shows that domestic work or care activities seem to be competitive with other productive activities that are not associated with the family-household sphere, such as formal volunteering. By contrast, men exhibit higher levels of formal volunteering, and their engagement in care activities are not competitive but cumulative with formal volunteering (Choi, Burr, Mutchler & Caro, 2007). Research focusing on grandparents confirms this gendered pattern (Arpino & Bordone, 2017; Hank & Buber, 2009). Arpino, Bordone & Balbo (2018) acknowledge this: "A vast literature shows that grandmothers provide more grandchild care than grandfathers do, attributing such gender difference to the gendered tasks, responsibilities, and expectations traditionally associated with grandparenthood" (Arpino, Bordone & Balbo, 2018: 252). Qualitative research shows that how grandparents spend time with grandchildren is also gendered: "While it was evident in the interview data that the pleasure of spending time with grandchildren and developing a close relationship is cherished by grandmothers and grandfathers alike, it was also clear that grandmothers assumed responsibilities for domestic chores alongside childcare" (Horsfall & Dempsey, 2015: 1082).

3.2.3 Grandparental Obligations and the Provision of Grandchild Care

Researchers acknowledge that people rate grandparenthood as highly important and that it represents a salient role in later life (Mahne & Motel-Klingebiel, 2012). However, this acknowledgement does not mean that grandparenthood necessarily involves a caregiver role.

Existing research on the effects of supplementary childcare on grandparents' health, well-being, and related outcomes is inconclusive, as it indicates positive (Arpino, Bordone & Balbo, 2018; Di Gessa, Glaser & Tinker, 2016a; Di Gessa, Glaser & Tinker, 2016b) and negative (Brunello & Rocco, 2019; Szinovacz & Davey, 2006) findings. Furthermore, studies that analyzed within-person changes over time found no link between grandchild care and grandparents' self-rated health, depressive symptoms, life satisfaction, meaning of life, and subjective life expectations (Ates, 2017; Danielsbacka, Tanskanen, Coall & Jokela, 2019; Sheppard & Monden, 2019). These studies' results indicate that the positive relationship between supplementary grandchild care and health or well-being instead reflects a selection rather than a causal effect. Danielsbacka, Tanskanen, Coall & Jokela (2019) found a small within-person effect only for ADL limitation (Activities of Daily Living).

Aside from methodological issues, a substantial explanation for these inconclusive findings could be that the influence of care depends on societal expectations placed on grandparents. Neuberger & Haberkern (2014) show that providing grandchild care is positively related to well-being in European countries with strong care obligations. The association is not statistically significant in those countries with low societal expectations on grandparents to provide childcare. Arpino, Bordone & Balbo (2018) find stronger associations for caregiving grandmothers than grandfathers and argue ". . . that grandmothers are usually more socially expected to provide care to their grandchildren, thereby perceiving lower costs and more rewards associated with such a role" (Arpino, Bordone & Balbo, 2018: 259).

Both studies' authors argue that a social role and its associated activities only become relevant to well-being if social expectations and obligations are linked to the role. In Germany, the grandparental caregiver role is important. In a European ranking of grandparental care obligations, Germany ranks in the upper third (Neuberger & Haberkern, 2014).

3.2.4 Hypotheses

My rationale is summarized as follows. The productivity norm addresses men and women in later life, but it focuses on typically male behavior. This makes it structurally easier for men to comply with the narrative. The social expectation of providing grandchild care, however, primarily addresses grandmothers. Only a few women succeed in meeting both expectations, which puts the majority of women in a structurally ambivalent position because, as in motherhood, the activity areas are systematically competitive. Grandmothers might be torn between family responsibilities and other expectations related to productivity. By providing grandchild care, grandmothers fulfill their gendered grandparental duties. When they combine grandchild care with volunteer activities, they also meet the productivity norm. Because they live up to social expectations, they are not reduced to a single purpose in life (role enhancement). Furthermore, volunteering may buffer stress and conflicts that emerge from providing grandchild care, and provide resources for gaining or maintaining well-being, such as social integration and self-determination. In sum, I argue that grandmothers in particular experience grandchild care as role enhancement if they combine it with activities not associated with the family–household sphere.

Hypothesis 1: Providing grandchild increases grandmothers' life satisfaction. The effect will be stronger if grandmothers combine grandchild care with formal volunteering.

Grandfathers generally experience less pressure to provide grandchild care. As discussed above, men are traditionally less responsible for domestic work and care but exhibit higher proportions of formal volunteering and other productive activities outside the household, and the provision of grandchild care does not crowd out volunteer activities for men (Arpino & Bordone, 2017). Grandfathers' engagement in grandchild care is not a barrier for engagement in other life domains, but an additional purpose in life. Furthermore, qualitative research shows that grandfathers are less involved in domestic and demanding parts of care but more involved with activities related to leisure and fun. Therefore, grandfathers may experience grandparental childcare as role enhancement.

Hypothesis 2: Providing grandchild care increases grandfathers' life satisfaction regardless of whether they combine grandchild care with volunteering.

A combination of grandchild care and informal care might lead to a double care burden and cause stress and conflict. Care providers could, for example, be forced to choose between

prioritizing grandchildren or other family members with care needs (e.g., spouses or parents). Furthermore, this double care burden might narrow the social networks to the sphere family. Research shows that homogeneous networks (e.g., neighbors, friends, and others) are detrimental to survival (Ellwardt et al., 2015). Thus, I expect a negative effect on life satisfaction for both grandmothers and grandfathers.

Hypothesis 3: Providing grandchild care decreases the life satisfaction of both grandmothers and grandfathers if they combine grandchild care with informal care.

3.3 Design and Methods

3.3.1 Data and Sample

I used the DEAS, a nationwide survey of the German population age 40 and older. The survey includes various baseline samples (1996, 2002, 2008, and 2014) and several follow-ups (Klaus et al., 2017). For this study, I applied a) the baseline 1996 sample and its 2002 follow-up, b) the baseline 2002 sample and its 2008 follow-up, and c) the baseline 2008 sample and its 2011 and 2014 follow-ups. In the latter subsample, follow-ups were conducted every three years instead of every six years. Therefore, I took advantage of both follow-ups. The main survey was conducted through personal interviews. Participants were then asked to respond to an additional questionnaire that collected sensitive information. Life satisfaction was measured in this drop-off questionnaire.

The pooled baseline sample contained 14,127 individuals. In the first step, I excluded participants for four reasons: 1) no drop-off questionnaire (14.2%), 2) no follow-up interview available (58.3%), 3) item nonresponse (14.4%), and 4) no full information in baseline survey (0.04%). After exclusion, the sample contained 4.133 individuals with 9,611 person-years of observation. Descriptive sample characteristics are presented in Table 1. Women comprise 49.0 % of the sample, and the mean age is 61.6 (SD=11.3). In the second step, I generated two samples suited for the corresponding analysis. For Analytical Sample 1, I excluded those observations that indicated an exit from grandchild care and volunteering. Thus, a genuine within-person effect can be identified that only takes into account the initiation of these activities. This procedure further reduced the sample by 14.9%. In Analytical Sample 2, I excluded those observations that indicated an exit from grandparental childcare and informal

care. In this case, the sample was further reduced by 16.4%. The sample selection process is described and visualized in Figure S1 in the Online Appendix.

3.3.2 Measures

Life satisfaction is measured using five items from the satisfaction with life scale developed by Diener (2000). The Items are: In most ways my life is close to my ideal; The conditions of my life are excellent; I am satisfied with my life; So far, I have gotten things I want in life; If I could live my life over, I would change almost nothing." The variable is calculated as the mean value of the scale if participants responded to at least to three out of five items. The DEAS applies a 5-point scale with the following response categories: "strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree." Higher variable values indicate higher life satisfaction levels.

The DEAS measures grandchild care with a single item: "Do you look after or supervise other people's children privately, e.g., your grandchildren or the children of siblings, neighbors, friends, or acquaintances?" Multiple answers are possible. The main explanatory variable—grandchild care—appears as 1 if participants identify themselves as grandchild caregivers. It appears as 0 if participants provide no care at all or if they provide care exclusively for nongrandchildren. The models included a second variable, childcare (nongrandchildren), to control for participants who provide care for nongrandchildren. In this case, the variable appears as 1. It appears as 0 if participants provide no care at all or if they provide care exclusively for grandchildren.

Formal volunteering is measured as a dummy variable and appears as 1 if observations volunteer in groups or organizations (0=no volunteering). Informal care is also measured as a dummy variable and appears as 1 if participants provide care for people with needs (0=applies no informal care).

All models control for a set of relevant time-varying covariates. They include dummies for the number of children including the categories no children (reference category), 1-2 children, and 3+ children, and the number of grandchildren including the categories no grandchildren, 1-2 grandchildren, and 3+ grandchildren. Partnership status is captured with a dummy variable (0=no relationship; 1=in relationship). Self-rated health is measured as a single item coded from 1= very bad to 5= very good. Employment status is captured with 3 dummy variables including employed (reference category), not employed, and retired. Furthermore, the models include

dummies for age categories and dummies capturing the interview year to adjust for period effects.

3.3.3 Analytical Strategy

As discussed above, some theoretical and empirical research acknowledges that privileged populations are more likely to provide grandchild care and engage in productive activities in later life. To approach a causal effect of grandchild care, I adjusted for such a selection bias in the regression analysis. The fixed-effects panel approach is an acknowledged standard for controlling for unobservable time-invariant individual factors (e.g., class, ethnicity, and education) that might cause a selection effect (Brüderl & Ludwig, 2015). Therefore, the fixed-effects model extracts unit-specific means and applies only with within-person variation. This allowed me to make statements about within-person changes throughout the observed period. Within-person changes in activity arrangements are presented in Table 2. All analyses are stratified by gender.

The models include interaction effects to estimate the effects of activity combinations. For each combination of grandchild care and another activity, I run separate models. In a recent working paper (Giesselmann & Schmidt-Catran, 2018), the authors point out that standard interaction terms in the fixed-effects approach do not identify a genuine within-person effect. For the purposes of this analysis, I address the problem in a simple way because each model deals with two categorical variables. Instead of multiplying the two variables with each other, it is possible to include indicators for each combination of the two variables (Giesselmann & Schmidt-Catran, 2018). The interpretation of the coefficients is explained in the results section.

I addressed selectivity due to panel and drop-off attrition and nonresponse with inverse probability weighting (Vandecasteele & Debels, 2006). I used logistic regression models to estimate the probability that a person participated in the baseline survey and survived the selection process to generate the analytical samples (see Figure A1 in the Online Appendix). I generate the weights as the inverse of the predicted probabilities and standardized to the mean value 1. Thus, the number of observations in the weighted analysis equals the number of observations in the unweighted analysis. The logistic regression models are presented in the Online Appendix (Table A1). I estimate separate models for men and women, including all control variables applied in the actual analysis. In addition, I take educational status into account.

3.4 Results

3.4.1 Sample Characteristics and Selection Effects

The descriptive statistics are summarized in Table 1, showing weighted and unweighted values. As expected, more women provided grandchild care and informal care than men. In addition more men volunteered than women. Table 2 presents the within-person changes in productive activities; the corresponding regression coefficients (see Table 3 and Figures 1 and 2) are based on these number of changes.

Table 1: Sample characteristics

	Women		**Men**	
	Not weighted	**Weighted**	**Not weighted**	**Weighted**
	Mean (SD)		*Mean (SD)*	
Life satisfaction	3.86 (0.73)	3.84 (0.74)	3.83 (0.70)	3.82 (0.71)
Self-rated health	2.62 (0.77)	2.58 (0.77)	2.59 (0.77)	2.55 (0.77)
	%		*%*	
No. children = 0	10.96	11.38	12.46	12.96
No. children = 1-2	65.37	64.36	62.21	61.67
No. children = 3+	23.67	24.26	25.33	25.37
No. grandchildren = 0	49.44	48.07	49.25	49.21
No. grandchildren = 1-2	26.00	26.21	24.82	24.62
No. grandchildren = 3+	24.56	25.72	25.94	26.17
In relationship				
Grandchild care	16.10	15.89	12.83	12.13
Grandchild care exit	5.14	5.18	4.40	4.18
Childcare (non-grandchildren)	5.59	5.29	3.18	3.13
Formal volunteering	18.53	15.55	23.53	20.50
Formal volunteering (exit)	3.95	3.20	5.63	4.91
Informal care	18.89	17.52	12.07	11.54
Informal care (exit)	6.48	5.78	5.16	4.75
Employed	40.34	38.09	39.21	38.64
Not employed	16.21	16.64	6.40	6.64
Retired	43.45	45.27	54.38	54.72
40-49 years	19.16	19.25	15.15	15.65
50-59 years	30.08	28.55	24.96	24.79
60-69 years	27.38	26.11	26.24	25.00
70-79 years	19.31	20.98	26.84	26.81
80-91 years	4.06	5.11	6.81	7.75
NT (Person-year observations)	4,707		4,904	
N (Individuals)	2,014		2,119	

Table 2: Within person changes in activity arrangements

	Women	Men
Change into:		
No grandchild care # Volunteering	148	163
Grandchild care # No volunteering	147	111
Grandchild care # Volunteering	56	56
N (no. of individual*year observations)	4,040	4,138
n (no. of individuals)	1,761	1,816
No grandchild care # Informal care	226	171
Grandchild care # No informal care	139	137
Grandchild care # Informal care	60	40
NT (Person-year observations)	3,873	4,162
N (Individuals)	1,688	1,828

I began the analysis by estimating models that include only main effects and no interactions. I estimated these models using fixed- and random-effects (see Table 3). The random-effects model is not a genuine within-person estimator. It utilizes within- and between-person variances to estimate regression coefficients. When comparing these approaches, the random-effects model indicate a positive and highly significant association between volunteering and life satisfaction. In the fixed-effects model, this coefficient shrinks by about 41% for men and by about 67% for women compared to the random-effects value. The fixed-effects coefficients are not statistically significant. The Hausman test indicates that the random-effects model is biased due to unobserved (time-invariant) heterogeneity, so the fixed-effects estimates are more consistent. Thus, the positive association between volunteering and life satisfaction reflects a selection effect rather than a causal effect. This finding supports the argument in critical gerontology that specific populations with sufficient socioeconomic resources are able to carry out volunteer work.

With regard to grandchild care, the coefficients of the random- and fixed-effects models are identical for men, indicating no significant association. For women, the fixed-effects coefficient is much smaller compared to the random-effects model. However, the coefficients for women are larger than for men and indicate a negative direction.

A second selection source is sample selectivity. The logistic regression models (see Table A1 in the online appendix) show that participants who have higher education, are in better health, and are engaged in productive activities are overrepresented in the analytical samples. Weights derived from these logistic models are therefore applied in the main analysis. In the Online Appendix, I present tables with the full regression outputs for weighted and unweighted models (Tables A2–A3). A comparison of the weighted and unweighted coefficients for productive

Table 3: Main effects of linear random-effects and fixed-effects regression models on life satisfaction **(Men and Women)**

	Men			
	Random-Effects		**Fixed-Effects**	
	B	*SE*	*B*	*SE*
Analytical sample 1:				
Grandchild Care	0.030	0.037	0.029	0.051
Formal Volunteering	-0.107***	0.028	0.063	0.047
Observations (Individuals)		4,138 (1,816)		
Hausman Test		$Chi^2(20) = 144.44$, $p < 0.000$		
Analytical sample 2				
Grandchild Care	0.018	0.036	0.025	0.050
Informal Care	-0.024	0.034	0.003	0.044
Observations (Individuals)		4,162 (1,828)		
Hausman Test		$Chi^2(20) = 158.34$, $p < 0.000$		
	Women			
	Random-Effects		**Fixed-Effects**	
	B	*SE*	*B*	*SE*
Analytical sample 1:				
Grandchild Care	-0.072*	0.037	- 0.057	0.053
Formal Volunteering	0.124***	0.032	0.035	0.049
Person-year observations (Individuals)		4,040 (1,761)		
Hausman Test		$Chi^2(20) = 136.89$, $p < 0.000$		
Analytical sample 2				
Grandchild Care	- 0.097**	0.038	- 0.073	0.054
Informal Care	0.043	0.030	0.018	0.038
Person-year observations (Individuals)		3,873 (1,688)		
Hausman Test		$Chi^2(20) = 130.95$, $p < 0.000$		

Note: * $p < 0.05$, ** $p < 0.001$, *** $p < 0.001$
Unstandardized and unweighted regression coefficients *(B)* and standard error *(SE)*.
All covariates are included.

activities suggests that the unweighted models are underestimated. For all following analyses, I present and discuss only the results of the weighted regression models. Coefficient plots (with 95% confidence intervals) of the interaction models for women and men are presented in Figures 1 and 2, respectively.

3.4.2 Results of the Interaction Effects for Women

Figure 1 section (A), shows the results for the combination of grandchild care and formal volunteering. As both variables contain two categories, four possible combinations exist. The reference category is provide no grandchild care and no volunteering. The coefficients can be interpreted as the within-person changes from the reference category into one of the three combinations. For the category "Provide grandchild care # Volunteering", it is also possible that a person is already volunteering and is transitioning into grandchild care or vice versa.

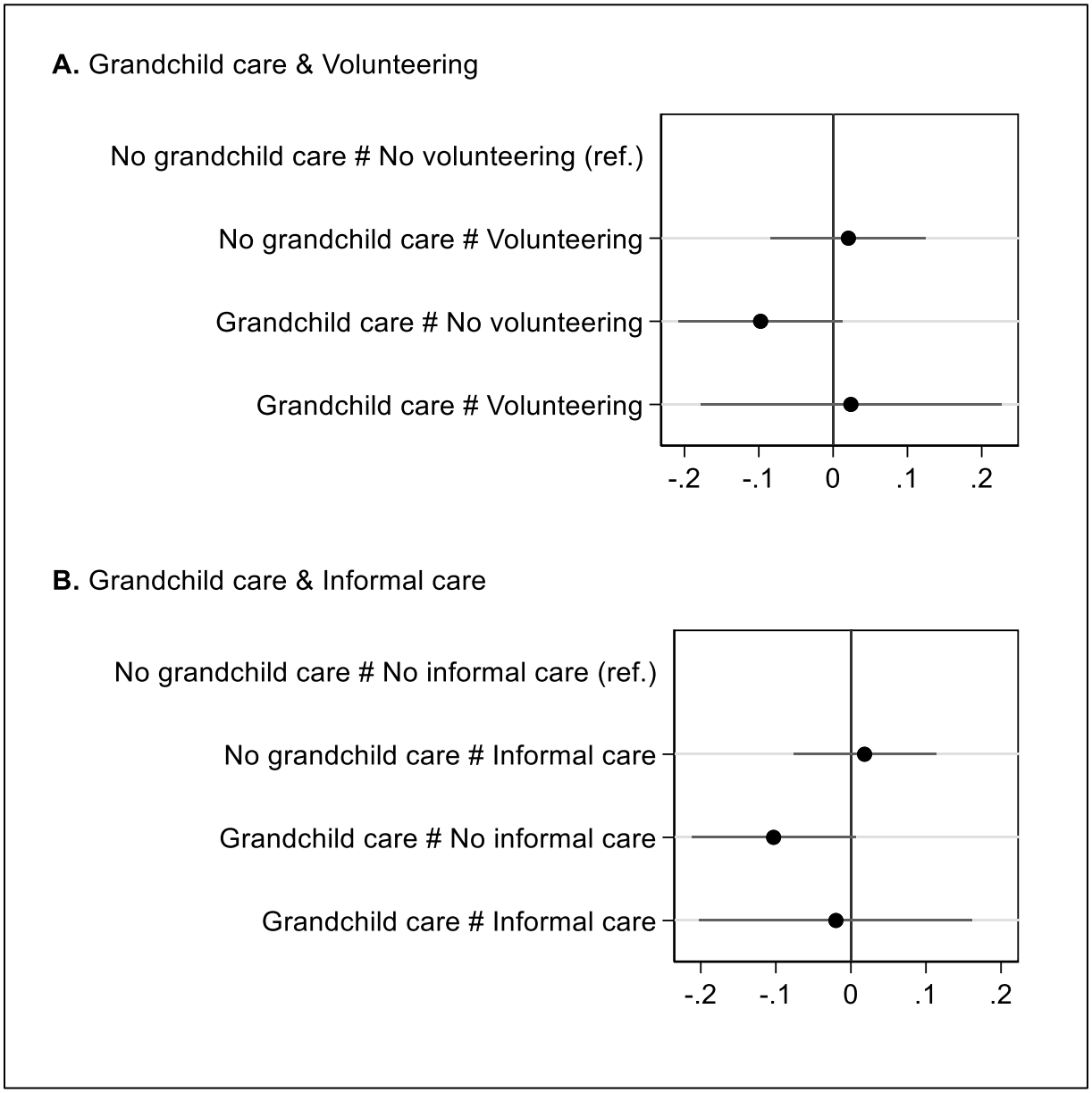
Hypothesis 1 predicted a generally positive effect for providing grandchild care and grandmothers' life satisfaction, which should be greater in magnitude if combined with formal volunteering. The findings do not support Hypothesis 1. Life satisfaction decreased when women began to provide grandchild care but did not combine this activity with volunteering. Although the negative main effect was not significant (Table 3), the effect for those who only provided grandchild care was larger in magnitude and significant at the 10% level (Figure 1, section A). The negative effect disappears when grandchild care is combined with volunteering. Life satisfaction is not affected when women begin volunteering but provide no grandchild care.

Figure 1 section (B) reveals a similar situation. If grandmothers provided only grandchild care, this had a negative effect on life satisfaction (significant at the 10% level). Again, the negative effect vanished when combined with another activity—in this case, informal care. This contradicts Hypothesis 3, which predicted a strong negative effect for this combination.

3.4.3 Results of the Interaction Effects for Men

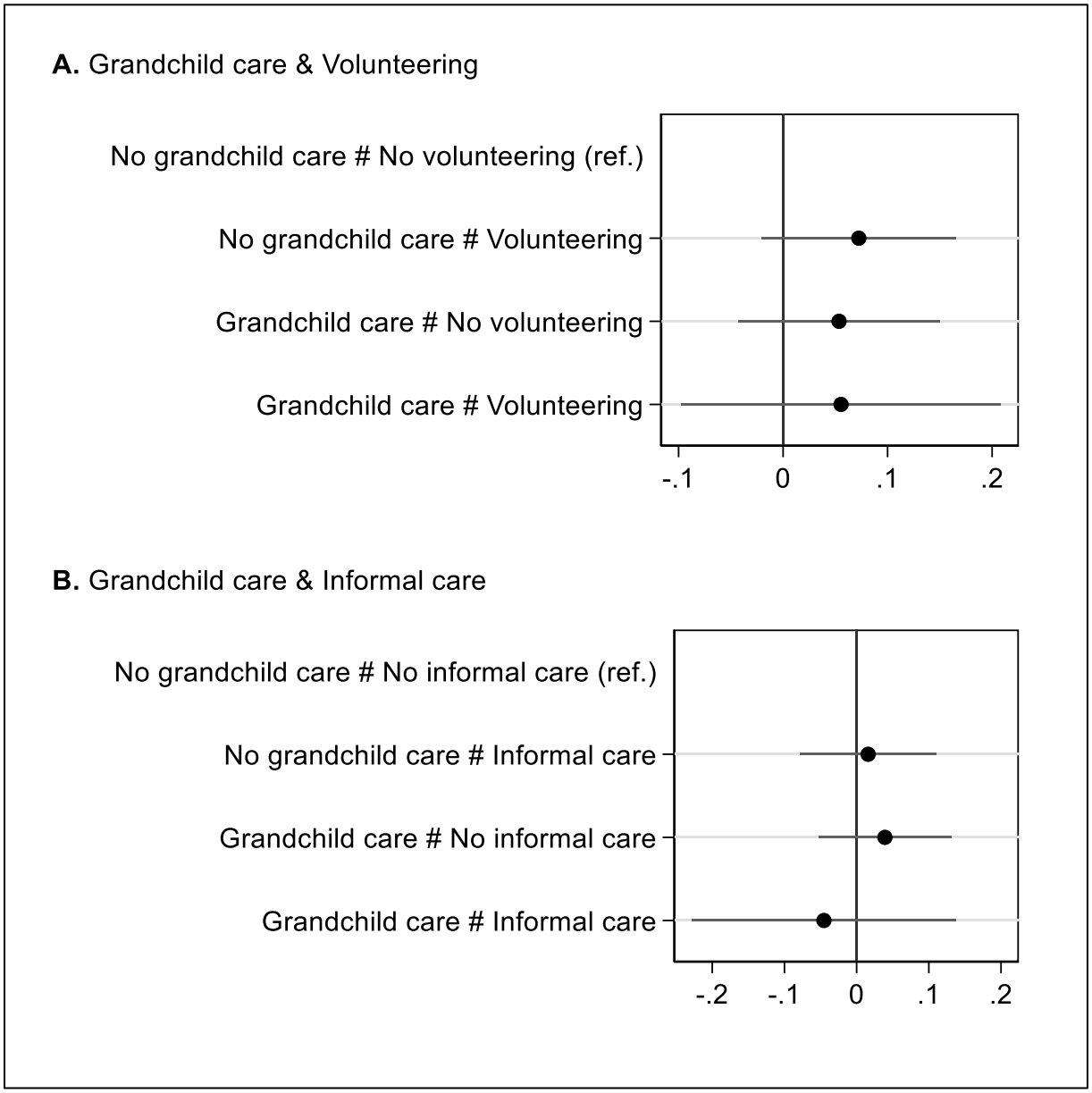
Based on this analysis, grandchild care was not related to grandfathers' life satisfaction, regardless of whether it was combined with formal volunteering, informal care, or no other activity (Figure 2). This contradicts Hypothesis 2, which predicted a positive effect in both cases. It also contradicts Hypothesis 3, which predicted a negative effect.

Figure 1: Interaction effects of within-person changes in productive activities (linear fixed-effects regression) on life satisfaction **(Women)**



Note: Unstandardized and weighted regression coefficients with 95%-confidence intervals. A. Based on Model (2), and B. based on Model (4) in the Online Appendix. All covariates are included.

Figure 2: Interaction effects of within-person changes in productive activities (linear fixed-effects regression) on life satisfaction **(Men)**



Note: Unstandardized and weighted regression coefficients with 95%-confidence intervals. A. Based on Model (6), and B. based on Model (8) in the Online Appendix. All covariates are included.

3.4.4 Sensitivity Analyses

The analyses indicated some borderline effects for women, so I carried out a number of robustness checks for women. These supplementary analyses also applied the generated weights to adjust for sample selection. Because the selectivity analysis reduced the sample considerably, I only compared the effect sizes and ignored the significance of the coefficients.

I first attempted to account for the grandchildren's age to ensure that the grandchild care variable was not related to caring for adult grandchildren. Since 2008, the DEAS has measured the age of a person's grandchildren. However, this information was not included in prior waves. Therefore, I identified the age of grandmothers in the 2008 baseline sample with grandchildren not older than 15 years. The grandmothers' average age was 64.2 years, with a standard deviation of 9.1. Next, to ensure a second step of sensitive analysis, I restricted the sample to grandparents not older than 73 (upper threshold of the average age by one standard deviation, 64.2+9.1=73.3). The results did not change.

Second, I excluded those individuals who engaged in grandchild care, voluntary work, and informal care continuously during the observed period. These individuals did not exhibit a change and might have biased the results if the causal effect decreased or increased over time (Ludwig & Brüderl, 2018). Again, the results did not substantially change.

Third, I considered the combination of three activities, for example: a) grandchild care with informal care only for those women who did not volunteer, b) the combination of grandchild care and volunteering separately for working and retired grandmothers, and c) the combination of grandchild care and informal care separately for working and retired grandmothers. However, the findings are contradictory and they are based on even less within-person changes, compared to the main analysis. Therefore, I have decided against reporting these results and to point out that future research—with a larger sample size—is needed at this point.

Finally, I estimated all models separately for the three baseline samples: a) the 1996 baseline sample and is 2002 follow-up, the 2002 baseline sample and its 2008 follow-up, and c) the 2008 baseline sample and its 2011 and 2014 follow-ups. This revealed that the negative effect of only providing grandchild care was mainly driven by the 1996 baseline sample, as the effect declined in the 2002 baseline sample and vanished in the 2008 baseline sample.

3.5 Discussion

Promoting health and well-being in later life has become a major concern in aging societies. In this study, I acknowledged that grandparenthood plays a central role in later life and highlighted its chronological overlap with other significant aspects of life. Important research questions that can be derived from this study include how grandparents fulfill duties within the family and participate in activities outside the family–household sphere to meet expectations based on the productivity norm. I was particularly interested in grandparents who provide grandchild care in combination with formal volunteering and informal care and how these combinations affect grandparents' life satisfaction. Therefore, my study focused on the gendered division of productive activities within and outside the family context.

In summary, the within-person analyses indicate that transitioning into grandchild care does not lead to major changes in life satisfaction. This is in line with other studies that apply a within-person analysis (Ates, 2017; Danielsbacka, Tanskanen, Coall & Jokela, 2019; Sheppard & Monden, 2019). Furthermore, the results indicate that for men, the positive association between volunteering and life satisfaction reflects a selection effect and that no significant association exists between grandchild care and life satisfaction. Against this background, a critical examination of the concepts of successful and productive aging seems appropriate, as these concepts suggest a causal relationship. For women, the results are not as clear as for men. On the one hand, it remained unclear whether the 1996 baseline sample indicated a negative effect on life satisfaction for women who only provide grandchild care. In addition, it was unclear whether some kind of social change occurred, as this negative effect was not observed for the 2008 baseline sample. On the other hand, there are at least some hints that the combination of grandchild care and volunteering enhance life satisfaction. This favors the role enhancement theory for the combination of gendered productive activities. For women, it might be important to reconcile activities within and outside the family sphere in the context of grandparenthood. At this point, however, further research involving a large number of within-person changes is necessary, also to consider combinations of more than two activities. There is no evidence for the role strain approach for women or men, as illustrated by the fact that the combination of grandchild care and informal care does not negatively influence life satisfaction.

Strengths and Limitations

One conceptual strength of this work is that the literature on grandchild care is more explicitly embedded in the debate on productive activities, thereby acknowledging aspects of multiple-

role occupation, gender, and critical gerontology. Empirically, the longitudinal fixed-effects approach is a strong tool to control for selection based on unobserved (time-invariant) heterogeneity. Considering selection effects is crucial, as the critical gerontology literature and the comparison of the random- and fixed-effects models have indicated. The working sample's selectivity was addressed with inverse probability weighting.

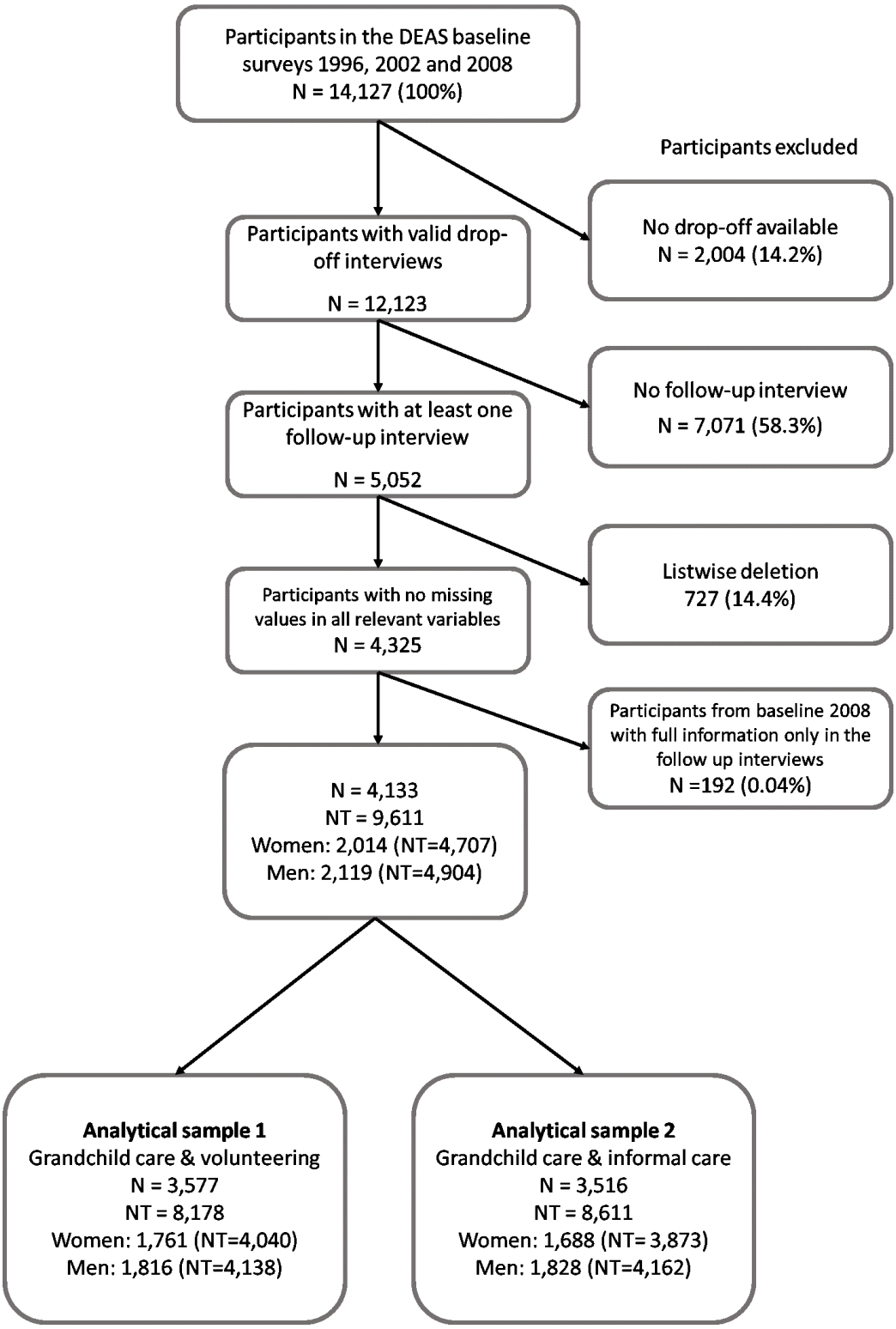
One major limitation of this study is its sample size. Compared to the whole sample size, the within-person changes of the activities are limited to a relatively small number of events, especially for the combinations. This is related to a second limitation: the measurement of productive activities. Due to the small sample size, it was not possible to differentiate between low and high levels of grandchild care, formal volunteering, and informal care. Furthermore, I must acknowledge the long periods between the waves.

Policy Implications

The productivity narrative suggests that volunteering is a win-win situation in which people in later life contribute to their communities while actively promoting personal well-being. The results of this study, however, do not support this causal relationship for a single activity or for combinations of activities. However, policies encourage productive activities to promote health and well-being in later life. Political action thus relies on the individual's responsibility to support society while increasing personal well-being. The empirical evidence, however, is questionable. In conclusion, a critical approach to the productivity narrative remains important. Researchers must pay more attention to selection and causation issues in this field of research. The fact that such questions remain unanswered must also be communicated to the public. Otherwise, policy makers, social workers, and other practitioners could operate under not verified assumptions.

3.6 Appendix

Figure S1: Sample Selection



Note: N=Individual, NT=Person-year observation.

Table A1: Attrition analysis: Logistic regression models to generate attrition weights for inverse probability weighting

	Women		**Men**	
	OR	*SE*	*OR*	*SE*
Self-rated health	1.196***	(0.041)	1.192***	(0.043)
	0.264***	(0.069)	0.223*	(0.087)
No. children = 0	ref.		ref.	
No. children = 1-2	0.991	(0.091)	1.157	(0.111)
No. children = 3+	0.970	(0.104)	1.084	(0.123)
No. grandchildren = 0	ref.		ref.	
No. grandchildren = 1-2	0.978	(0.080)	0.944	(0.080)
No. grandchildren = 3+	0.940	(0.087)	0.924	(0.093)
In relationship	1.211*	(0.106)	1.309***	(0.091)
Grandchild care	1.255*	(0.114)	1.079	(0.094)
Formal volunteer	1.581***	(0.108)	1.792***	(0.152)
Informal care	1.279*	(0.112)	1.293***	(0.099)
Employed	ref.		ref.	
Not employed	0.918	(0.083)	0.879+	(0.068)
Employed	0.742*	(0.103)	0.873	(0.126)
Age categories (39-49)				
50-59 years	1.241*	(0.100)	1.355***	(0.106)
60-69 years	1.414*	(0.157)	1.524***	(0.155)
70-79 years	1.366*	(0.178)	0.980	(0.130)
80-91 years	0.731	(0.152)	0.453***	(0.103)
Low education	ref.		ref.	
Medium-level education	1.632***	(0.233)	1.663***	(0.139)
Higher-level education	2.199***	(0.339)	2.444***	(0.279)
High-level education	3.000***	(0.445)	2.813***	(0.297)
Missing value in education	1.050	(1.191)	1.000	(.)
N (Individuals)	6788		6595	

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.001$, *** $p < 0.001$

Table A2: Linear fixed-effects panel regression on life satisfaction **(Women)**

	Analytical sample 1 (Grandchild care and volunteering)				**Analytical sample 2** (Grandchild care and informal care)			
	Not weighted analyses		Weighted analyses		Not weighted analyses		Weighted analyses	
	Model (1)		**Model (2)**		**Model (3)**		**Model (4)**	
	B	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*
No. children (0)	ref.		ref.		ref.		ref.	
No. children (1-2)	-0.006	(0.143)	-0.011	(0.151)	0.098	(0.145)	0.079	(0.153)
No. children (3+)	-0.050	(0.167)	-0.045	(0.176)	0.057	(0.174)	0.046	(0.183)
No. grandchildren (0)	ref.		ref.		ref.		ref.	
No. grandchildren (1-2)	0.059	(0.047)	0.053	(0.050)	0.051	(0.050)	0.045	(0.053)
No. grandchildren (3+)	0.024	(0.085)	0.028	(0.091)	0.007	(0.087)	0.019	(0.093)
In Relationship	0.109*	(0.055)	0.115*	(0.058)	0.164*	(0.058)	0.165*	(0.061)
Childcare (non-grandchildren)	0.066	(0.046)	0.055	(0.050)	0.028	(0.048)	0.026	(0.053)
Self-rated health	0.084***	(0.020)	0.088***	(0.021)	0.088***	(0.021)	0.091***	(0.022)
Age categories (60-69)	ref.		ref.		ref.		ref.	
39-49 years	0.112	(0.069)	0.109	(0.073)	0.131^{+}	(0.069)	0.128^{+}	(0.074)
50-59 years	0.076^{+}	(0.046)	0.074	(0.048)	0.079^{+}	(0.047)	0.080	(0.050)
70-79 years	0.012	(0.046)	0.019	(0.048)	-0.001	(0.049)	0.011	(0.051)
80-91 years	-0.084	(0.093)	-0.081	(0.095)	-0.084	(0.095)	-0.076	(0.097)
Interview year (2008)	ref.		ref.		ref.		ref.	
1996	-0.034	(0.067)	-0.038	(0.070)	-0.028	(0.070)	-0.031	(0.074)
2002	0.075	(0.046)	0.071	(0.049)	0.077	(0.047)	0.073	(0.050)
2011	0.059*	(0.023)	0.064*	(0.024)	0.068*	(0.024)	0.071*	(0.025)
2014	0.082*	(0.029)	0.086*	(0.031)	0.089*	(0.030)	0.090*	(0.031)

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Table A2 (continued)

Employed	ref.		ref.		ref.		ref.	
Not employed	-0.074	(0.050)	-0.091^{+}	(0.052)	-0.078	(0.051)	-0.092^{+}	(0.054)
Retired	0.142*	(0.056)	0.126*	(0.060)	0.126*	(0.058)	0.117^{+}	(0.061)
Formal volunteering					0.035	(0.037)	0.031	(0.039)
Informal care	-0.005	(0.031)	0.004	(0.032)				
No grandchild care # No volunteering	ref.		ref.					
No grandchild care # Volunteering	0.018	(0.052)	0.021	(0.053)				
Grandchild care # No volunteering	-0.083	(0.056)	-0.098^{+}	(0.056)				
Grandchild care # Volunteering	0.048	(0.097)	0.024	(0.103)				
No grandchild care # No informal care					ref.		ref.	
No grandchild care # Informal care					0.005	(0.047)	0.018	(0.048)
Grandchild care # No informal care					-0.089	(0.055)	-0.103^{+}	(0.056)
Grandchild care # Informal care					-0.002	(0.090)	-0.020	(0.093)
Constant	3.422***	(0.143)	3.409***	(0.149)	3.272***	(0.145)	3.274***	(0.151)
R^2-within	0.034		0.035		0.036		0.037	
Person-year observ.	4040		4040		3873		3873	
(Individuals)	(1,761)		(1,761)		(1,688)		(1,688)	

Note: Unstandardized regression coefficients *(B)* and standard error *(SE)*

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.001$, *** $p < 0.001$

Table A3: Linear fixed-effects panel regression on life satisfaction **(Men)**

	Analytical sample 1 (Grandchild care and volunteering)				**Analytical sample 2** (Grandchild care and informal care)			
	Not weighted analyses		Weighted analyses		Not weighted analyses		Weighted analyses	
	Model (5)		**Model (6)**		**Model (7)**		**Model (8)**	
	B	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*
No. children (0)	ref.		ref.		ref.		ref.	
No. children (1-2)	-0.059	(0.094)	-0.043	(0.096)	-0.085	(0.086)	-0.077	(0.087)
No. children (3+)	0.076	(0.124)	0.098	(0.127)	0.069	(0.117)	0.078	(0.120)
No. grandchild. (0)	ref.		ref.		ref.		ref.	
No. grandchild. (1-2)	-0.020	(0.048)	-0.021	(0.050)	-0.028	(0.048)	-0.031	(0.051)
No. grandchild. (3+)	0.065	(0.066)	0.058	(0.069)	0.043	(0.067)	0.036	(0.070)
In Relationship	0.111	(0.074)	0.115	(0.074)	0.173*	(0.075)	0.170*	(0.076)
Childcare (non-grandchildren)	0.030	(0.058)	0.016	(0.059)	0.023	(0.050)	0.009	(0.052)
Self-rated health	0.110***	(0.019)	0.119***	(0.020)	0.094***	(0.019)	0.103***	(0.020)
Age categories (60-69)	ref.		ref.		ref.		ref.	
39-49 years	-0.047	(0.070)	-0.053	(0.073)	-0.025	(0.069)	-0.034	(0.072)
50-59 years	-0.032	(0.045)	-0.040	(0.047)	-0.012	(0.045)	-0.021	(0.047)
70-79 years	-0.040	(0.044)	-0.034	(0.045)	-0.059	(0.042)	-0.057	(0.043)
80-91 years	-0.013	(0.075)	-0.008	(0.078)	-0.078	(0.074)	-0.073	(0.076)
Interview year (2008)	ref.		ref.		ref.		ref.	
1996	-0.050	(0.064)	-0.059	(0.066)	-0.072	(0.063)	-0.078	(0.065)
2002	0.107*	(0.043)	0.105*	(0.044)	0.107*	(0.042)	0.104*	(0.044)
2011	0.067*	(0.022)	0.068*	(0.023)	0.086***	(0.021)	0.088***	(0.022)
2014	0.053+	(0.028)	0.055+	(0.029)	0.062*	(0.027)	0.065*	(0.028)

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Table A3 (continued)

Employed	ref.		ref.		ref.		ref.	
Not employed	-0.110^{+}	(0.060)	-0.121^{+}	(0.063)	-0.074	(0.060)	-0.083	(0.063)
Retired	-0.082	(0.053)	-0.091^{+}	(0.055)	-0.060	(0.052)	-0.075	(0.054)
Formal volunteering					0.032	(0.032)	0.041	(0.033)
Informal care	-0.009	(0.035)	-0.009	(0.036)				
No grandchild care # No volunteering	ref.		ref.					
No grandchild care # Volunteering	0.072	(0.047)	0.072	(0.047)				
Grandchild care # No volunteering	0.052	(0.048)	0.054	(0.049)				
Grandchild care # Volunteering	0.046	(0.074)	0.055	(0.078)				
No grandchild care # No informal care					ref.		ref.	
No grandchild care # Informal care					0.016	(0.047)	0.016	(0.048)
Grandchild care # No informal care					0.039	(0.046)	0.039	(0.047)
Grandchild care # Informal care					-0.035	(0.089)	-0.045	(0.093)
Constant	3.469***	(0.121)	3.429***	(0.123)	3.473***	(0.116)	3.448***	(0.118)
R^2-within	0.046		0.050		0.047		0.050	
Person-year observ.	4138		4138		4162		4162	
(Individuals)	(1,816)		(1,816)		(1,828)		(1,828)	

Note: Unstandardized regression coefficients *(B)* and standard error *(SE)*

+ p < 0.10, * p < 0.05, ** p < 0.001, *** p < 0.001

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4 Changes in Leisure Activities Before and After Grandparenthood

Abstract

Objectives: This study investigates the impact of grandparenthood and grandchild care on grandparents' involvement in leisure activities. In addition to the number and frequency of engagement in leisure activities, we also consider with whom they are carried out. Beside the possibility of a cumulation effect, the literature suggests that providing grandchild care might compete with leisure activities, especially for women.

Method: We use longitudinal data from the German Ageing Survey (DEAS) which contains rich information on leisure activities of people aged 40 and older. To account for selection into grandparenthood and provision of grandchild care, we use a within-unit estimation approach (fixed-effects panel models).

Results: Our results do not show significant changes in the leisure activities of either men or women that can be explained by grandparenthood or grandchild care. Only men slightly decrease the number of frequent leisure activities if they have two or more grandchildren, while they increase their engagement when providing care to their grandchildren.

Discussion: Contrary to concerns that grandparents' involvement might compete with leisure activities in later life, we do not find substantial evidence for that. When statistically significant effects are found, they tend to be small and related to the number of frequent activities. This means, that grandparents do not carry out less activities, but they slightly reduce their frequency. We conclude that grandparenthood and grandchild care do not have a noticeable impact on leisure activities.

4.1 Introduction

Grandparenthood is a central role in later life. People tend to rate the grandparent role as highly important, even before experiencing it (Mahne and Motel-Klingebiel, 2012). For grandparents, contact with grandchildren and emotional closeness to them have been found to be beneficial for their well-being (Drew and Silverstein, 2007; Mahne and Huxhold, 2015), whereas loosing contact to their grandchildren is a harmful experience (Drew and Silverstein, 2007). The literature in this field has mainly focused on the consequences of grandchild care on grandparents' health and well-being (Arpino, Bordone & Balbo, 2018; Ates, 2017; Di Gessa, Glaser & Tinker, 2016a; Di Gessa, Glaser & Tinker, 2016b; Hughes, Waite, LaPierre & Luo, 2007). We contribute to the existing literature, by examining an intermediate aspect in the relationship between grandparental childcare and well-being. In this respect, both theoretical and empirical studies emphasize the importance of engagement in activities for aging well (Adams, Leibbrandt & Moon, 2011; Lemon, Bengtson & Peterson, 1972; Rowe & Kahn, 1997). In a similar vein, a few studies have investigated the relationship between grandchild care and participation in other activities (Arpino & Bordone, 2017; Bulanda & Jendrek, 2016). However, they are often limited to social activities (mostly with a focus on volunteering), which are usually carried out by selected groups (e.g., high socio-economic status) and more often by men (Burr, Mutchler & Caro, 2007; Hank & Erlinghagen, 2010; Musick & Wilson, 2010). More generally, we are interested in how everyday life is affected when people become grandparents or start providing grandchild care. Thus, we widen the perspective and consider a broader range of different leisure activities. Our first research question is therefore "Do a) having grandchildren and b) providing grandchild care compete with or add to engagement in leisure activities?" We consider the number of leisure activities carried out frequently (i.e., at least several times a week) and those carried out regularly (i.e., at least monthly). In this way we take into account the possibility that people remain engaged in the same number of activities after their transition to grandparenthood and when they start looking after their grandchildren, but adapt the frequency of engagement.

While being active in general has been shown to be a modifiable risk factor for cognitive decline and it plays a decisive role in influencing health and survival (Engelhardt, Buber, Skirbekk & Prskawetz, 2010; Hultsch, Hertzog, Small & Dixon, 1999; Scarmeas & Stern, 2003), social networks research has shown that such a positive impact is especially present when people are embedded in complex and diverse networks (Ellwardt, Aartsen & van Tilburg, 2017; Ellwardt

et al., 2015). This means that, in addition to engagement within the family, it is a valuable resource to have (frequent) contact with non-family members, such as neighbors, friends or others. Grandparenthood and grandparental childcare might not only influence the number and frequency of leisure activities, but also with whom these activities are carried out. Our second research question is whether after becoming grandparents and when providing grandchild care individuals change with whom they engage in leisure activities (i.e., relatives and friends) and whether this effect is gendered.

Our theoretical arguments mainly focus on the concept of multiple role occupation (role strain vs. role enhancement). As role expectations are gendered, we also assume that the consequences of grandparenthood and grandchild care will also differ by gender. We discuss gender specific considerations in the Background section and in the empirical analyses we estimate separate models for men and women.

We add to the existing evidence in four respects. First, by relying on data from the German Ageing Survey (DEAS) we are able to consider a wide range of 13 leisure activities. Second, we account for the multidimensionality of grandparenthood, by considering the transition to grandparenthood, number of grandchildren, and engagement in grandchild care. Third, we consider different aspects related to involvement in leisure activities by including information on number, frequency and with whom activities are carried out. Fourth, methodologically, we use a fixed-effects panel approach, which allows us to account for within-individual variation over time, controlling for unobserved time-constant variables.

4.2 Background

4.2.1 The Grandparenthood Effect

Most of the research in the area of grandparenthood has focused on grandparental childcare. Yet, in Europe about 50% of grandparents provide grandchild care (Igel & Szydlik, 2011); in Germany about 30% (Mahne & Klaus, 2017). Therefore, care provision to grandchildren is only a part of the multidimensional role of grandparents, and according to the concept of linked lives (Tanskanen, 2017) grandchildren might affect the lives of their grandparents even if grandparents do not provide care to them. Grandparents may for example join common family activities and visit the zoo, go for walks in the park or join school events. These examples

illustrate that becoming a grandparent might alter both the frequency of (some) leisure activities and with whom they are carried out.

Indeed, over the life course, individuals engage in various activities, both within and outside the family. While family members and intimate friends form a person's ''primary social groups'' (Cooley, 1912), people with whom one interacts at clubs, organisations, and the workplace form an individual's ''secondary social groups''. In line with the social convoy model (Kahn & Antonucci, 1980), over time social networks change not only in size but also in composition in ways that are not always actively or rationally directed by the individual but rather shaped through linked (family) events over the life course (Antonucci & Akiyama, 1987). Due to traditional gender-related role models (e.g., male-breadwinner and female-caregiver) in family and society, gender plays a fundamental role in how such processes may affect social networks of individuals. As kin-keepers women tend to have more contact to relatives than men do (Bracke, Christiaens & Wauterickx, 2008; Dubas, 2001; Danielsbacka, Tanskanen, Coall & Jokela, 2019), which can be observed in different stages of life. After the birth of the first child, contact frequency between mothers and their daughter increases (Tanskanen, 2017). Even women with large networks (measured as high number of network members) who have frequently contact to neighbors, tend to replace them by family members in later life (Aartsen, van Tilburg, Smits & Knipscheer, 2004). This gendered pattern continues with grandmotherhood, who provide more grandchild care than grandfathers do. This is not only because women are socialized into the kin-keeper role (Leopold & Skopek, 2014). According to the doing gender approach, men and women accomplish gender with their everyday behavior by following typical masculine or feminine associated activities (symbolic enactment of gender) (West & Zimmerman, 1987). By doing gender, they generate their gender identity and reproduce the same gendered role models across the life-course.

Although grandchildren could generally be considered as an opportunity structure for leisure activities, we expect that especially women (as traditional kin-keepers) will experience a change in their leisure activities when they become grandmothers, by increasing the number of activities carried out because they might carry out more activities with family members. For the transition into grandparenthood, which is not automatically linked to time and energy consuming activities like care, we do not expect a decrease for the number of leisure activities. For the same reason we do not assume that a decrease in activities with family members would increase activities carried out with friends and others. For clarification, please note that our

measures of with “whom activities are carried out” are not mutually exclusive. Respondents can for example increase the number of activities they carry out with family members and with friends at the same time (see section on Variables).

For men (who largely do not function as kin-keepers) we expect no substantial effects on leisure activities when they become grandfathers.

We consider not only the transition into grandparenthood, but also the number of grandchildren. We do not assume a linear relationship with leisure activities because resources, such as time, are limited. Therefore, we will apply nonlinear measures (see section on Variables).

4.2.2 The Grandchild Care Effect

Looking after grandchildren might foster grandparents’ engagement in leisure activities by stimulating their sense of purpose in life (Silverstein & Giarrusso, 2013) and promoting their active lifestyle. Against this background, role enhancement theory assumes that social roles come along with resources, ego gratification and personal growth (Sieber, 1974). These arguments would favor a cumulation hypothesis: grandparents involved in childcare cumulate this activity with leisure activities. Research supporting the cumulation hypothesis has interpreted the positive correlation between engagement in various activities as the result of a general motivation for being active or, with reference to care and volunteering, as the ‘‘super helper’’ effect, i.e., a high commitment to helping others (Hank & Stuck, 2008). These findings rather point to a selection effect instead of a casual effect, meaning that individuals with certain observed and unobserved characteristics tend to cumulate leisure activities. Yet, even after accounting for these selection effects, Bulanda and Jendrek (2016) found that non-residential grandchild care leads to more non-family activities, such as volunteering. However, they did not stratify their analyses by gender, while other studies found opposite evidence, i.e. of competition between grandchild care and engagement in other activities, but only for women. For example, Arpino and Bordone (2017), using an instrumental variable approach, found that a regular provision of grandchild care has a significant negative effect on the number of activities in which grandmothers participate. When considering the activities separately by type they also showed, for grandmothers only, a negative effect on volunteering, engagement in educational or training courses, and participation in political or community-related organizations. Additionally, a recent latent class analysis accounting for different types of

activities provided evidence of competition between care-related and other productive activities for women (Arpino & Bordone, 2018).

From a theoretical perspective, the role strain theory (in contrast to the role enhancement) poses that multiple social roles can be time-consuming, and physically and psychologically demanding (Goode, 1960). Thus, caregiving can be taxing and it might take away resources from older adults (Jendrek, 1993). Similarly, engaging in grandchild care may reduce willingness, energy, and time availability to carry out those activities that do not involve grandchildren (Koslowski, 2009), but also reduce the pressure to search for social support outside the family. As a result, grandparents may be more selective in their choice of social and leisure activities when they regularly look after their grandchildren. These arguments would favor a competition hypothesis, namely that, net of the person specific general motivation and other unobserved characteristics, such as values or abilities, grandchild care might have a negative effect on participation in leisure activities.

While the role enhancement and role strain theories are gender neutral, the doing gender argument (West & Zimmerman, 1987) helps us to formulate a gender-specific hypothesis. Indeed, grandchild care is usually considered as a typical feminine activity, it might reinforce gender specific behaviors and represent an extension of maternal role. Qualitative research shows that while "… the pleasure of spending time with grandchildren and developing a close relationship is cherished by grandmothers and grandfathers alike, it was also clear that grandmothers assumed responsibilities for domestic chores alongside childcare" (Horsfall & Dempsey, 2015: 1082). It is the grandmothers who most often deal with the exhausting tasks of grandchild care. Grandfathers spend more time together with grandchildren with leisure activities. Therefore, a competitive (role strain) effect of grandparental childcare with other leisure activities appears more plausible for grandmothers, whereas a cumulation (role enhancement) effect appears as more plausible for caregiving grandfathers.

Although we expect the role strain argument to hold when it comes to providing grandchild care, for our broad measurement of leisure activities we do not necessarily expect a decrease for the number and intensity of activities grandmothers carry out, because our indices include activities that grandmothers might carry out with their grandchildren, e.g. going for a walk or visiting sporting events. However, we assume that there will be a significant change regarding "with whom" activities are done. As explained with regard to the concept of linked lives, women tend to have more contact to family members than men and providing grandchild care

might be one mechanism that leads to this gendered phenomenon. Grandmothers who look after their grandchildren might carry out fewer activities with friends and others and shift their activities more into the sphere of the family.

According to the doing gender perspective grandfathers providing grandchild care might compensate outside the family in order to accomplish and (re-)construct their masculinity. A similar argument is used to explain why women still tend to do more housework even if their relative earnings is higher compared to their partners earning. It is a strategy of maintaining their gender identity even if the male breadwinner norm is violated (Brines, 1993). In this sense, we can empirically observe that spousal care (Choi, Burr, Mutchler & Caro, 2007) and grandchild care (Arpino & Bordone, 2017) are not competitive with volunteering or other activities carried out outside the family-household sphere.

For grandfathers, we therefore assume they will carry out more leisure activities and that they will do these more frequently together with family members when they look after their grandchildren (role enhancement). However, we do not assume that grandparental childcare will decrease at the same time the activities grandfathers carry out with friends/others. They might either maintain their level, or possibly increase it as compensation for the extra time that takes place in the family context.

Given that some previous studies have shown that consequences of grandparental childcare emerge only when care is provided over a longer period of time (Di Gessa, Glaser & Tinker, 2016a; Hughes, Waite, LaPierre & Luo, 2007), we will also consider this in our analyses (see Working Sample 3).

4.3 Research Design

4.3.1 Analytical Strategy

In order to rule out possible selection effects, where unobserved individual characteristics might cause a selection into both the "treatment" and the outcome (Ludwig and Brüderl, 2018), we exploit the longitudinal dimension of DEAS and estimate linear fixed-effects panel models. This approach eliminates all time-invariant factors (observed or unobserved), thus exploiting only within-person variability, i.e. changes over time experienced by each individual. In this way, the presence of unobserved confounders does not bias the estimate if these variables are

time-invariant. For this reason, fixed-effects models are considered as a superior approach to standard regression models or random-effect panel models to approximate causality

In order to make the most out of the fixed-effects approach with respect to our research question, we consider separately the transition to grandparenthood (or an increasing number of grandchildren) and change in the provision of grandchild care. The reference category of this latter variable includes both grandparents not starting to look after grandchildren and respondents remaining grandchildless. Keeping those without grandchildren in the sample will help us to appropriately adjust for all covariates in the models but will not bias our grandchild care effects because the fixed-effect approach identifies an average effect only for those who experience a change. We therefore model the respective events rather than the status or the exit. To do so, we perform separate analyses for becoming a grandparent and providing grandchild care, relying on data prepared accordingly. In the next section, after describing the data used, we explain in more details how the models of analyses are hierarchically structured to the extent that we first include the grandparenthood variable and all control variables and, in a second step, we include a variable that captures if grandparents provide grandchild care. By doing so, we can explore if there is an independent grandparenthood effect or if the observed effect of grandparenthood on leisure activities is mediated by grandparental childcare.

Although we operate with count and dichotomous measures as dependent variables (see section on Variables), we will first present linear regression models, due to their more intuitive interpretation and, more importantly, due to the fact the coefficients obtained from hierarchically nested logistic models are not simply comparable to each other (Mood, 2010). In robustness checks, we will explore to what extent the results remain robust if we estimate logistic or Poisson models to account for the measurement characteristics of our dependent variables (Rüger & Viry, 2017).

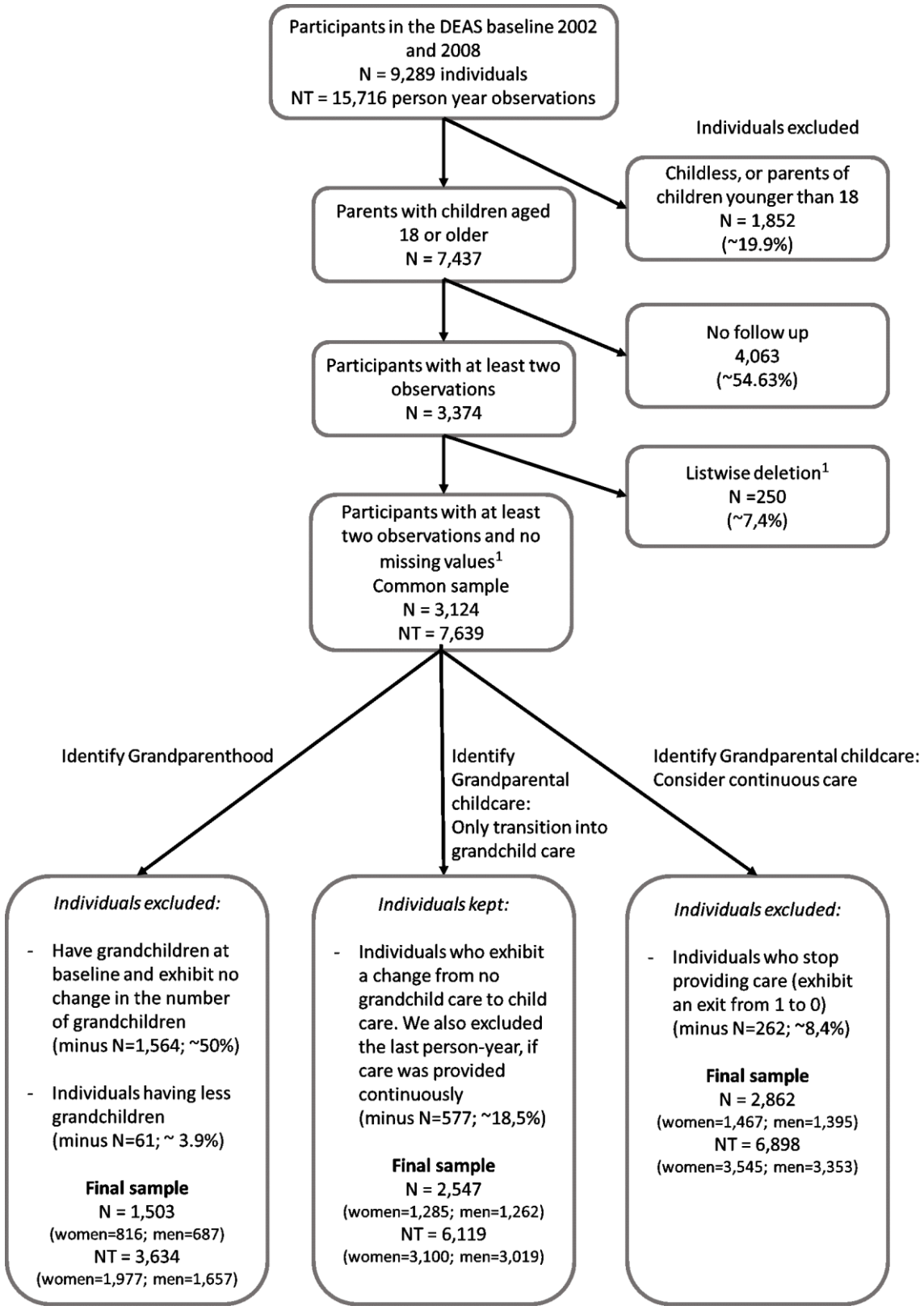
4.3.2 Data and Sample Selection

DEAS is a nationwide survey of the German population aged 40 and older (Klaus et al., 2017). It is designed as a cohort sequential survey currently consisting of 4 baseline samples (1996, 2002, 2008, and 2014) and several follow-ups. For this study, we use two baseline – follow-up sub-samples: a) we consider interviews in wave 2002 as baseline and those in 2008 as its follow-up, and b) interviews in 2008 as baseline and those in 2011 and 2014 as its follow-ups. In this latter case, we take advantage of two follow-ups because they are conducted within a 6-year

interval, which corresponds to the time between baseline and follow-up in sub-sample a). We do not use the data collected in 1996 because central control variables were not included (e.g., physical functioning).

After merging the two sub-samples, the sample includes N = 9,289 individuals (15,716 person-year observations). We excluded 1,852 participants who are childless or have children younger than 18 (i.e., the youngest child should not be younger than 18), to rule out that children of care age might bias the effect of grandchildren. We additionally do not consider 4,063 participants due to panel attrition and 250 participants due to item non-response (list wise deletion). The sample selection is illustrated in Figure 1.

Figure 1: Study sample flowchart based on data from the German Ageing Survey (DEAS), 2002-2014.



Note: 1. For the income variable, we have grouped cases with a missing value into one category, because of the high proportion of missing values (6.8%).

4.3.2.1 Identifying the effect of grandparenthood

Working Sample 1

First, we are interested in the transition into grandparenthood and the increase in the number of grandchildren. Therefore, we drop cases who are already grandparents at baseline interview and do not exhibit a change in the number of grandchildren. As for these observations the event of our interest (and the related effect on leisure activities) might have already occurred before our observation period (left-censored data), the average "treatment effect" of the event (change into treatment) might be biased if the "true causal effect" decreases or increases over time (Ludwig & Brüderl, 2018). We identified and dropped a small number of cases who have fewer grandchildren in the follow up than at baseline. Losing a grandchild is a peculiar negative event and might have important implications on leisure activities, but due to the small number of this sub-sample it could not be investigated separately. After applying the aforementioned selection criteria, for this first part of the analyses, the working sample counts 1,503 individuals (3,634 person-year observations).

4.3.2.2 Identifying the effect of providing grandchild care

In the second part of the analyses, we create two different sub-samples. Therefore, we distinguish between grandparents never providing grandchild care (0, 0), those starting (changing from 0 to 1), stopping (changing from 1 to 0), or continuing providing care (1, 1) to their grandchildren over two consecutive waves. The same logic is applied for those who are observed over 3 waves (see Table 1).

Working sample 2

In order to estimate coefficients that genuinely capture the effect of the transition into grandchild care (change from 0 to 1), we exclude respondents stopping or continuing providing care over the observation period. This also addresses the issue of a left-censored data structure (i.e., cases where respondents already provided grandchild care at baseline). Those who never provide care (0, 0) are considered as the control group. We also drop the last person year observation if care is provided two waves in a row (0, 1, 1 → 0, 1, drop), to make sure that we identify only the effect of transition into grandchild care. Table 1 illustrates the construction of this working sample in light grey (working sample 2: N=2,457; and 6,119 person-year observations).

Working sample 3

We acknowledge that the effect of grandchild care on engagement in leisure activities over a certain observation period might be more evident if grandchild care is provided over consecutive waves. Therefore, we build working sample 3 by adding to working sample 2 the sub-sample of respondents who continue to provide care over the observation period (1, 1). We therefore include all observations that are marked as light and dark grey in Table 1. To be able to model the effect of continuous care, we introduce an event clock variable that increases by one unit if an additional year of grandparental childcare is provided. The new values of this counter variable are presented in parenthesis in the corresponding cell of Table 1. As the effect may not be linear, we choose a dummy approach for this variable. The reference category consists of people not providing grandchild care across the whole observation period, whether they have grandchildren or not (working sample 3: N=2,862; and 6,898 person-year observations). The descriptive statistics of all three working samples are presented in the appendix (Tables A1-A3).

Table 1 Sample preperation for analysing the effect of grandchild care (0=no; 1=yes) on participation in leisure activities

Sample for the main analysis		
Cases with two person-year observations		
t_1	t_2	
0	0	
0	1	
1	0	
1	1 (2)	
Cases with three person-year observations		
t_1	t_2	t_3
0	0	0
0	0	1
0	1	1 (2)
0	1	0
1	1 (2)	0
1	0	0
1	0	1
1 (1)	1 (2)	1 (3)

Note: Numbers in parentheses refer to the value of the event clock variable to estimate the effect of continuous provision of grandchild care; light grey indicates working sample 2; light grey + dark grey indicate working sample 3.

4.3.3 Variables

Becoming a grandparent and the number of grandchildren are captured by three dummy variables considering whether the respondent is grandchildless (reference), has 1 grandchild, 2, or 3 or more grandchildren. DEAS measures grandchild care with a single item: “Do you look after or supervise other people’s children privately, e.g., your grandchildren or the children of siblings, neighbors, friends, or acquaintances?” Multiple answers are possible. The explanatory variable grandchild care takes value 1 if the respondent mentions to provide grandchild care (=0 nongrandparents or grandparents who do not provide care). We additionally control for whether the respondent provides care to children of siblings, friends, or neighbors, with a dummy variable.

We consider all leisure activities that are measured in the related module in DEAS: doing arts and crafts, using computer, doing crossword puzzles, gardening, playing board games, meeting friends, going to political meetings, doing sports, artistic activities, visiting cultural events, visiting sporting events, and attending classes/lectures.

For all these activities, respondents were asked how often they carry out these activities, with possible answers being “never”, “seldom”, “1-3 times a month”, “once a week”, “several times a week”, “daily”. Following Wetzel and Huxhold (2016), we recoded the original variables into a dummy format with 0=“never-seldom” and 1=“at least 1-3 times a month”. We then built a summary index of all activities that captures the **number of activities carried out on a regular basis** (from now on “number of regular activities”). Similarly, we built the index **number of frequent activities**, setting the following threshold: 0=“never-once a week”, and 1=“at least several times a week”. In this way we took into account the possibility that the number of activities carried out regularly might not change, but the number of those carried out frequently might.

For six of the above listed activities (going for a walk, doing sports, artistic activities, visiting sporting events, playing board games, attending classes), respondents were additionally asked with whom they engage in each activity. The response categories are “alone”, “with partner”, “with relatives”, “with friends”, “with a club”, “with others”. Multiple answers were allowed, if the activities are not predominantly executed alone. We used the available information to generate two outcome variables. The variable **with friends or others** counts the number of activities carried out with friends, with a club or with others (if at least one of these categories is mentioned). The variable **with relatives** is a binary indicator that equals one if at least one of

the activities is carried out with relatives (=0 otherwise). We have decided to use the dummy option (instead of the count option), because of the small number of within-person changes in the category "with relatives".

As we have estimated fixed-effects panel analyses (see above the section on analytical strategy for more details on this method), it was neither possible nor necessary to consider time-invariant variables. We controlled for a set of time-varying variables to account for selection into grandparental childcare ("selection into treatment"). The models included a dummy variable that identifies if participants are in a romantic relationship (=1 if respondent is in a relationship regardless of whether or not they live together; =0 otherwise), and two dummies to account for working status: working (reference), not working, and three dummies capturing years since retirement, because the relationship with leisure activities might be nonlinear: short- (0-5 years), medium (6-11 years), and long-term (12+). Physical functioning is captured by limitations in activities of daily living (e.g., walking stairs, to kneel or stoop down). Participants evaluate their physical impairment from 1 (severely limited) to 3 (not limited at all) for 10 daily activities listed (e.g. climbing stairs, walking several blocks, and bending). The standardized score ranges from 0 to 100, where higher values indicate better performance. Socio-economic status is measured by a generated DEAS variable on needs-adjusted monthly per head income of the household (according to the new OECD equivalence scale). Based on tertiles, we generated three dummy variables for low, middle, and high income. The tertiles division was calculated for each wave separately. Because of the high proportion of missing values in the income variable, we have grouped these cases in a missing category. To capture age and period effects, all models include age and interview year dummy variables.

The analyses are carried out separately for men and women.

4.4 Findings

To allow an easier interpretation of the results, the effects of grandparenthood, number of children and grandparental childcare are shown graphically in Figures 2 and 3 for men and women, respectively. All models presented include all control variables described above (full Tables are presented in the appendix, Tables A1-A8). For the interpretation of the coefficients, it should be noted that they are obtained from a genuine within unit estimation, representing a change within a person. For example, the coefficient of "1 grandchild" captures a person's transition into grandparenthood; while the effect of "2 grandchildren" can represent both a

change from no grandchildren to becoming a grandparent of two grandchildren and the change from having one to having two grandchildren. A similar interpretation applies to the coefficient of becoming a grandparent of "3+ grandchildren".

4.4.1 The Grandparenthood Effect

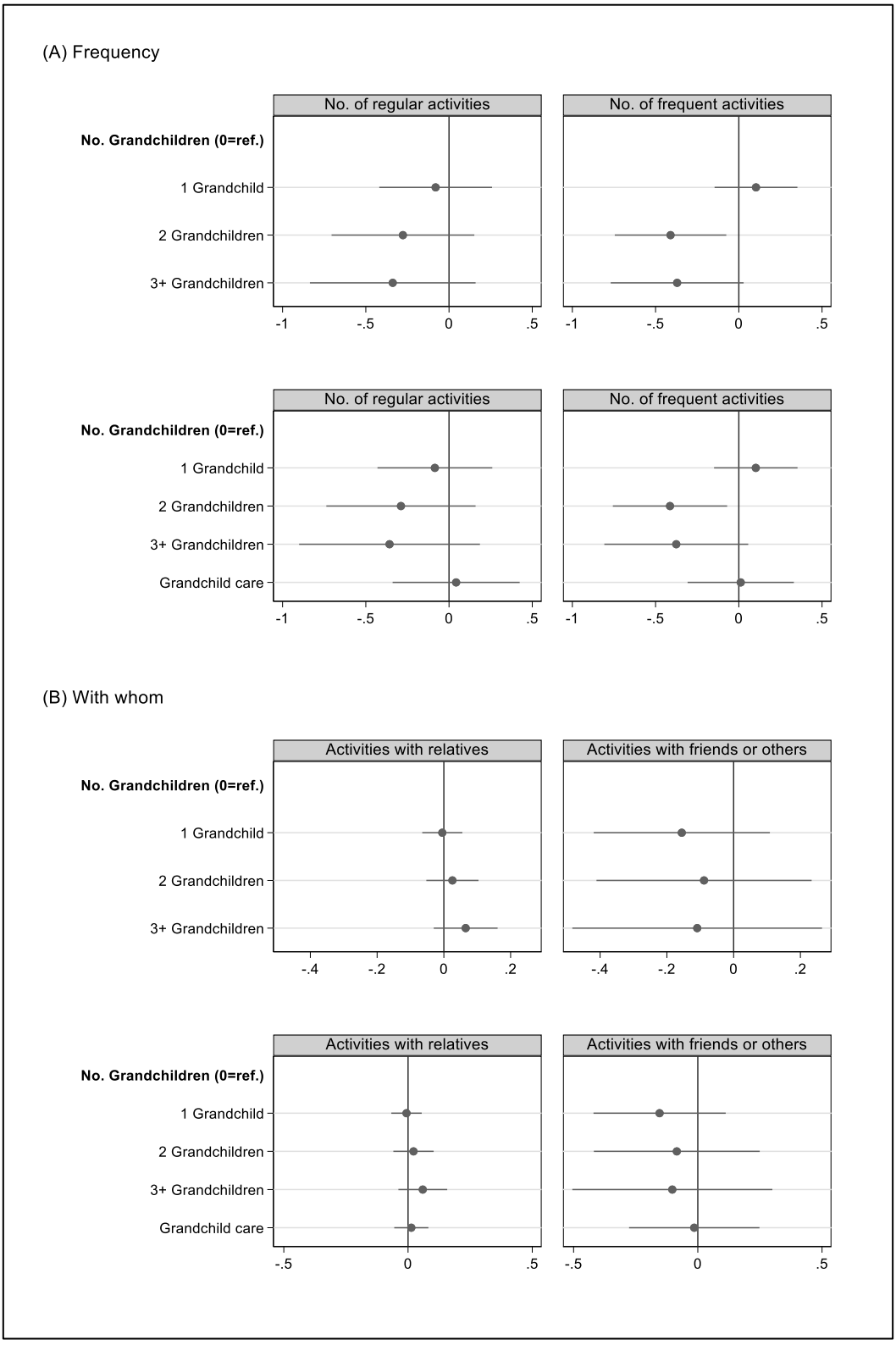
Among men, grandparenthood does not have a significant effect on the number of activities that are carried out regularly (Figure 2(A), upper left panel). We find a significant decrease in the number of frequent activities carried out by men with two (at 5% level) or more grandchildren (at 10% level) as compared to having no grandchildren (Figure 2(A), upper right panel). These effects remain similar when we account for the provision of grandchild care to make sure that the grandparenthood effect is not mediated by the provision of grandchild care (Figure 2(A), bottom panel). We will comment on the effect of grandchild care provision in the following section.

When looking at with whom men carry out leisure activities (Figure 2(B)), we do not find any significant effect following transition to grandfatherhood.

Similarly to becoming a grandfather, becoming a grandmother to the first or additional grandchildren does not affect the number of regular activities in which women engage (Figure 3(A), upper left panel). The number of frequent activities in which grandmothers of three or more grandchildren engage, slightly increases as compared to their grandchildless counterparts (Figure 3(A), upper right panel). The effect holds also when including grandchild care (Figure 3(A), bottom panel). We however acknowledge that in both cases the effect is only significant at the 10% level.

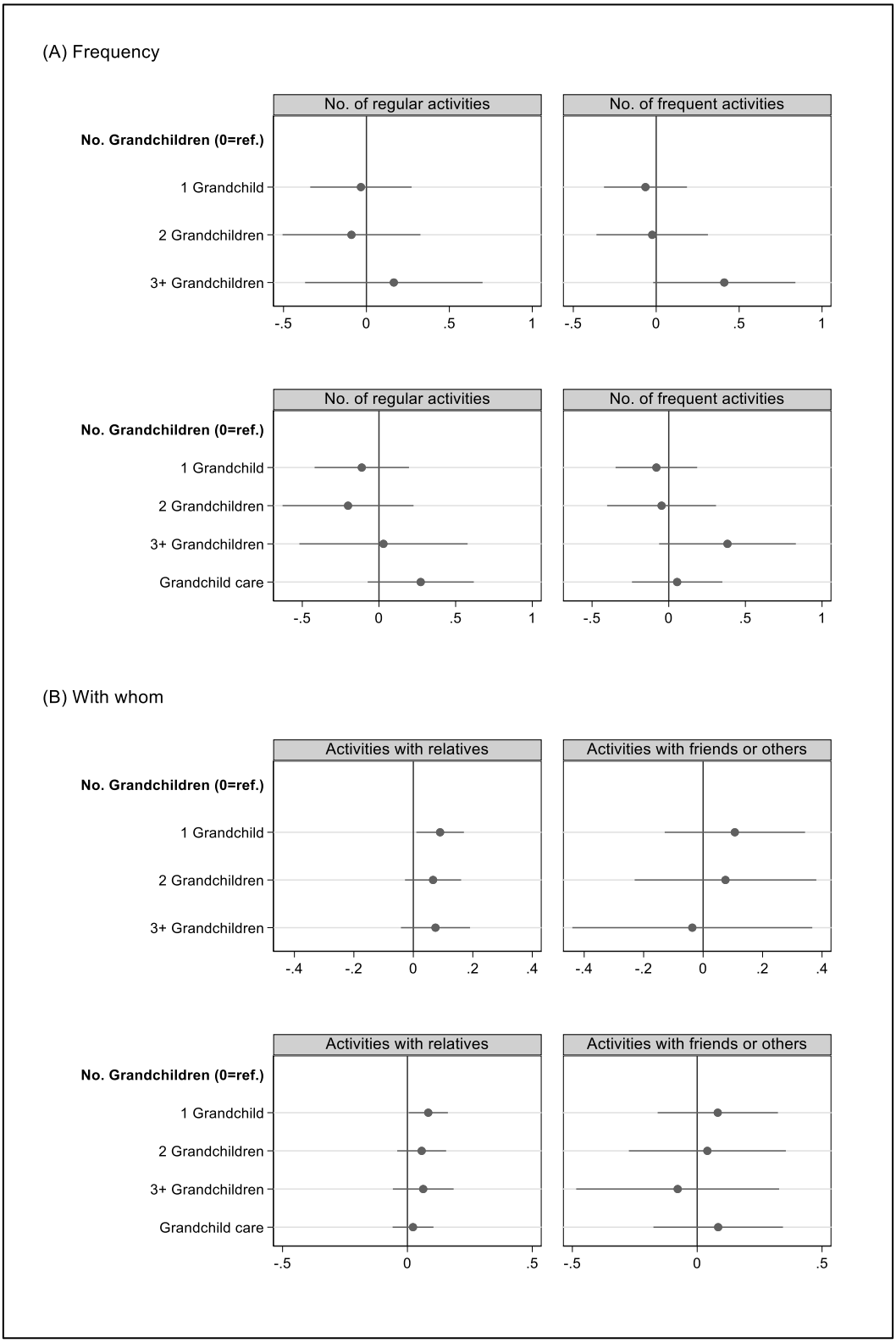
Figures 2(B) and 3(B) show that becoming a grandmother (but not a grandfather) slightly increases the probability of engagement in regular activities carried out with family members, even after accounting for the provision of grandchild care (beta coef. =0.084, std. err. =0.040). No change is observed in the number of activities carried out "with friends or others" for either men or women in association with grandparenthood.

Figure 2: Coefficients and 95% confidence intervals of **number of grandchildren** (without and with a control for grandchild care) on A) number of regular activities (left panel) and number of frequent activities (right panel) and B) doing at least one activity with relatives (left panel) and number of activities done with friends or others (right panel), from linear fixed-effects regression among **men**.



Note: Changes in No. of Grandchildren: "1 Grandchild" n = 92; "2 Grandchildren" n = 62; "3+ Grandchildren" n = 95. Grandchild care (reference category = grandchildless or grandparents who do not provide care). Working sample 1.

Figure 3: Coefficients and 95% confidence intervals of **number of grandchildren** (without and with a control for grandchild care) on A) number of regular activities (left panel) and number of frequent activities (right panel) and B) doing at least one activity with relatives (left panel) and number of activities done with friends or others (right panel), from linear fixed-effects regression among **women**.



Note: Changes in No. of Grandchildren: "1 Grandchild" n = 108; "2 Grandchildren" n = 74; "3+ Grandchildren" n = 95. Working sample 1. Grandchild care (reference category = grandchildless or grandparents who do not provide care). Working sample 1.

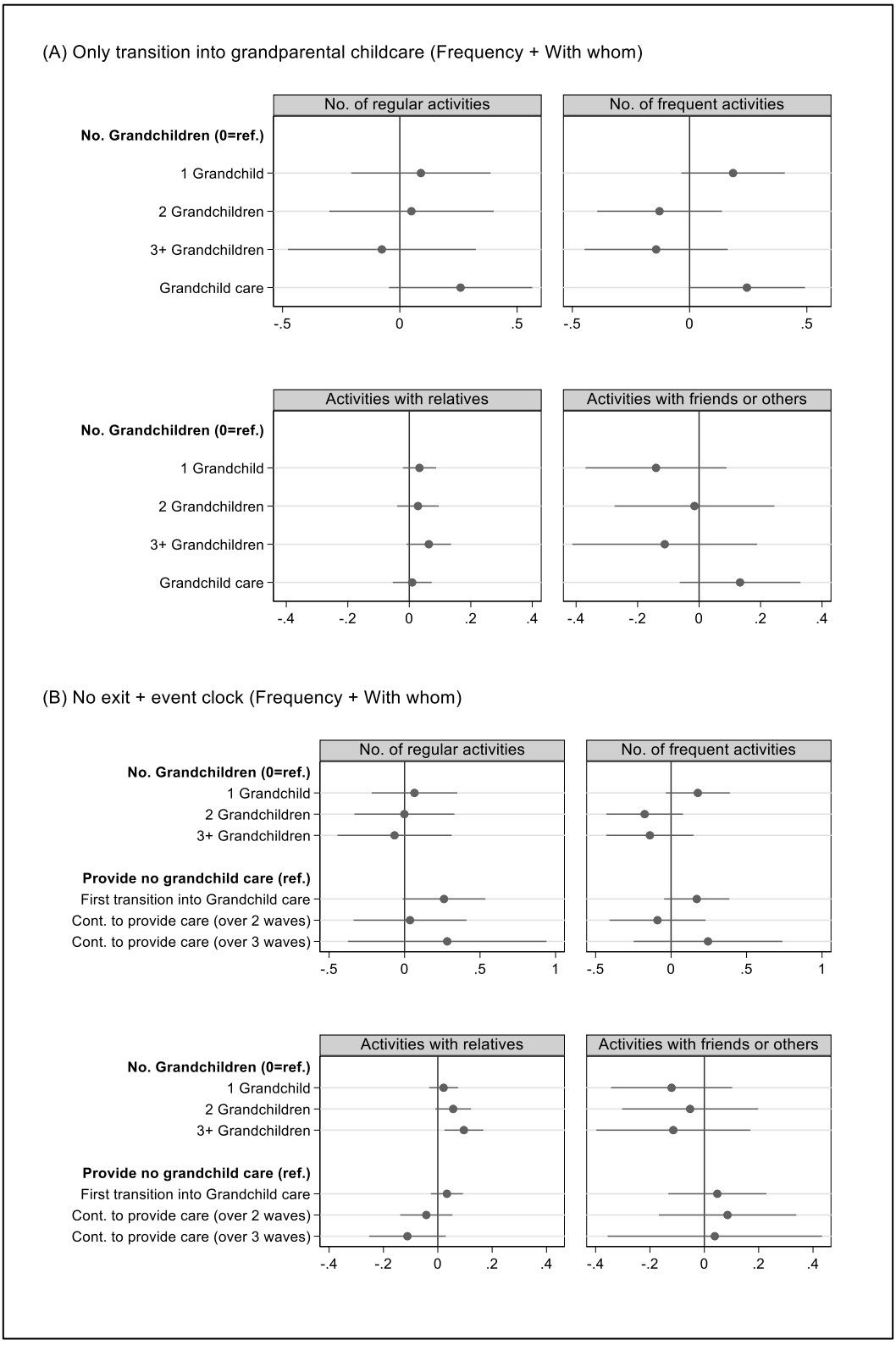
4.4.2 The grandchild care effect

The upper panel of Figures 4(A) and 5(A) shows the effect of starting to provide grandchild care for men and women, respectively. The reference category is "providing no care" (i.e., either the respondent has no grandchildren or is a grandparent but does not engage in grandchild care). Starting to provide grandchild care increases the number of frequent activities ($p=0.053$) carried out by grandfathers.

For neither men nor women a continuous provision of grandchild care affects with whom activities are carried out, as shown in the bottom panel of Figures 4(A) and 5(A).

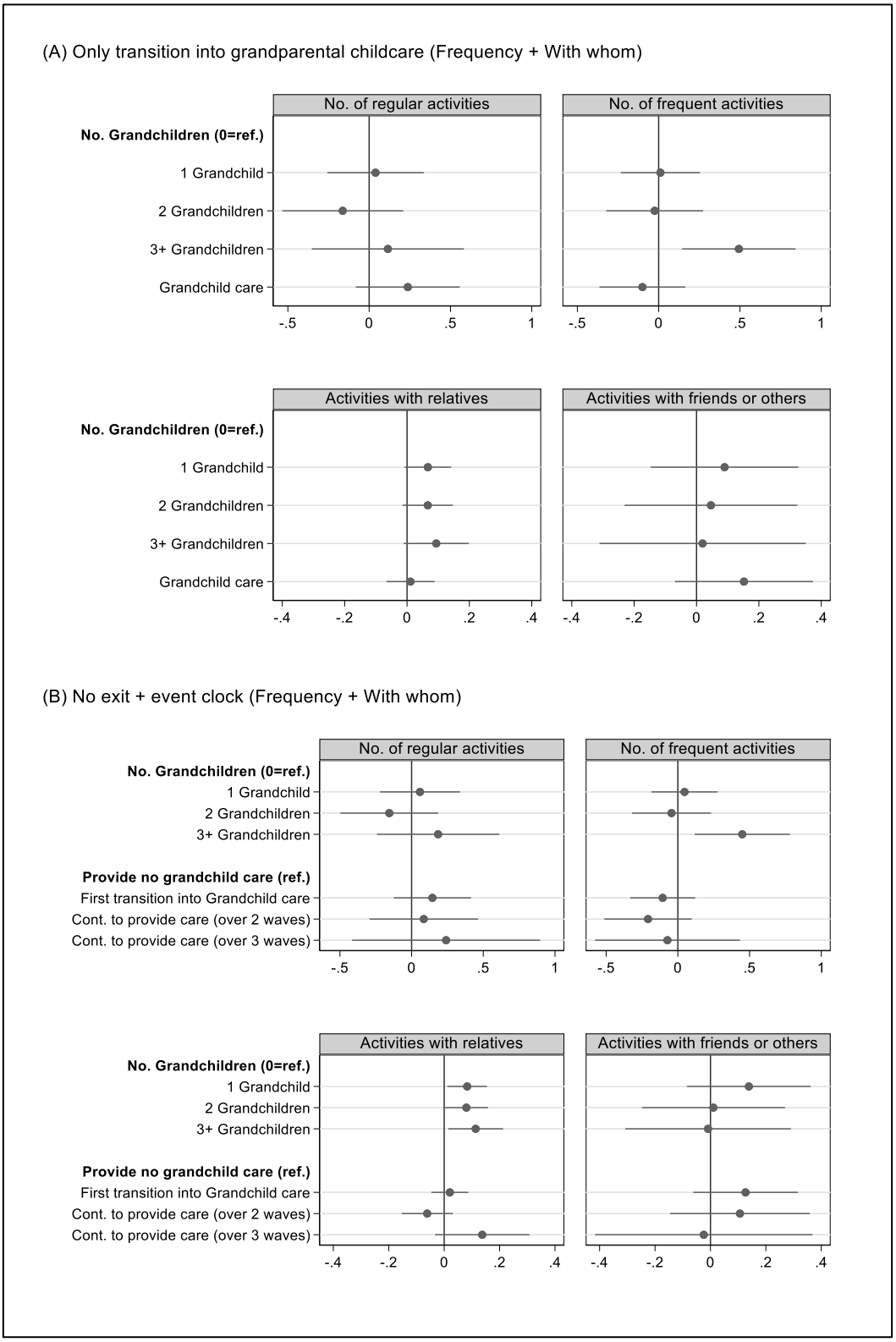
No changes emerge in terms of with whom respondents carry out leisure activities based on changes in their engagement in grandchild care (Figure 4(B) for men and Figure 5(B) for women).

Figure 4: Coefficients and 95% confidence intervals of **grandchild care** (controlling for number of grandchildren) on A) number of regular activities (left panel) and number of frequent activities (right panel) and B) doing at least one activity with relatives (left panel) and number of activities done with friends or others (right panel), from linear fixed-effects regression among **men.**



Note: a) Section (A): Change in Grandchild care n=138; b) Section (B): Changes in First transition n=171; Cont. care (2 waves) n=133; Cont. care (3 waves) n=35. Grandchild care (reference category = grandchildless or grandparents who do not provide care). Working sample 2+3.

Figure 5: Coefficients and 95% confidence intervals of **grandchild care** (controlling for number of grandchildren) on a) number of regular activities (left panel) and number of frequent activities (right panel) and b) doing at least one activity with relatives (left panel) and number of activities done with friends or others (right panel), from linear fixed-effects regression among **women**.



Note: a) Section (A): Change in Grandchild care n=146; b) Section (B): Changes in First transition n=189; Cont. care (2 waves) n=182; Cont. care (3 waves) n=38. Grandchild care (reference category = grandchildless or grandparents who do not provide care). Working sample 2+3.

4.4.3 Robustness checks

We conducted sensitivity analysis to test the robustness of our results. First, it may be that the effects on our independent variables might be driven by some of the 13 activities that we combined in our operationalization of leisure activities. Thus, we generated 13 different summary indices of number of regular activities and number of frequent activities, by excluding in turn one activity. For example, the index variable "arts & crafts excluded" is calculated considering 12 of the 13 activities, excluding "arts & crafts". We re-run the regression models with these indices and compare the results to those reported in Figures 2-4. For the sake of comparability of the coefficients between models, we transformed the indices in order to have the same range of values, following the equation: (new index * max. value of the original index) / max. value of the new index. The results of this rotating analysis are presented in Figures A1-A11, in the appendix. The re-estimated coefficients are scattering closely around their total effect, suggesting that the results of our main analysis are not driven by single activities. The only exception is the positive effect of grandmotherhood on activities carried out with relatives, which results to be mainly driven by the activity of "going for a walk".

Second, as our outcome "at least one activity carried out with relatives" is a dummy variable, we estimated the related models using fixed-effects logit regressions. The results (available upon request), do not highlight substantial differences to the main models reported here.

In a further sensitivity analysis, for the outcomes "number of regular activities", "number of frequent activities" and "at least one activity carried out with relatives" we estimated Poisson models in order to account for the measurement characteristic of the outcome variables. For the same reason, we estimated Logistic regression models for the outcome "activities carried out with friends" The results (available upon request) of the main analysis remain robust and can be confirmed.

4.5 Discussion

Using data from Germany, this paper investigated the effects of grandparenthood and grandparental childcare on engagement in leisure activities. Our results showed that, for both men and women, neither grandparenthood per se nor engagement in grandchild care significantly affect participation in leisure activities, with one exception for men. Grandfathers of two or more grandchildren tend to decrease the number of frequent leisure activities as compared to their grandchildless counterparts, but they increase their frequent engagement if

they provide care to their grandchildren. Bordone and Arpino (2016) observe a similar pattern with respect to subjective age: men aged 50-66 feel older when they have grandchildren. However, this effect does not exist for grandfathers of the same age when they provide care for their grandchildren. Against this background, one explanation for our findings could be related to psychological effects, which makes men reduce the frequency of leisure activities when they become grandfathers, because subjective age is related to factors such as role involvement and well-being. In contrast, providing care might boost their sense of purpose. Especially as it is possible to do some of these activities together with their grandchildren, which might be the reason why the number of frequent activities increases again. This aspect is an interesting avenue for future research.

However, it must be said that the effects mentioned above are small and refer to the number of frequent activities. This means, that grandfathers do not carry out less activities, but they slightly reduce their frequency. We conclude that grandparenthood and grandchild care do not have a noticeable impact on leisure activities and social networks.

We acknowledge that some of the point estimates show large confidence intervals. One reason for this is likely the limited within person variability, i.e. changes over time that are exploited by the fixed-effects models, that results in an uncertain estimate. Furthermore, the impact of grandparenthood and grandchild care on leisure activities may depend on grandparents' resources. Future research might consider stratifying the analyses according to socio-economic status or age. Unfortunately, due to the small number of within person changes in our sample, we could not do so in the present study. Another limitation to this study, relates to the relatively long periods between survey waves in DEAS. Shorter periods would be more appropriate to observe short-term effects of life course events as grandparenthood.

Although there is still not a univocal answer to whether and how grandparenthood and grandparental childcare affect grandparents' health, wellbeing and social participation, we can conclude that previous analyses based on a between-variation approach might have overestimated the effect of grandparenthood and grandchild care, possibly due to selection effects. Our study contributes to this strand of the literature, showing that grandparenthood and grandparental childcare do not positively affect participation in leisure activities and social networks, but we also find that transitions into these new roles do not negatively affect social participation. These ("non")findings are particularly relevant in terms of policy implications. For women in particular, we expected that especially being involved in grandparental childcare

could lead them to carry out leisure activities less frequently and to shift their activities into the family sphere, thus neglecting other important relationships, e.g. with friends. This was however not confirmed in our study. Therefore, according to our findings grandparents and grandchild caregivers should not be identified as an at-risk group with regard to their ability to engage in leisure activities.

4.6 Appendix

Table A1: Sample characteristics for the analysis of the grandparenthood effect (*working sample 1)*, % or mean and standard deviation, by gender

	Women		**Men**	
	%	Mean (St.D.)	%	Mean (St.D.)
Number of regular activities (0-12)[1]		5.51 (1.99)		5.56 (1.94)
Number of frequent activities (0-8) [1]		2.60 (1.43)		2.70 (1.40)
Activities carried out with friends and others (0-6) [1]		1.43 (1.32)		1.15 (1.21)
At least one activity carried out with relatives (0;1)	13.10		7.36	
No grandchildren	74.71		72.66	
1 Grandchild	10.02		10.62	
2 Grandchildren	9.05		8.99	
3+ Grandchildren	6.22		7.72	
Provide grandchild care	10.02		8.87	
In a relationship	82.40		92.40	
Working	60.50		52.08	
Not working	13.71		8.21	
Short-term retired (0-5 years)	13.10		16.72	
Medium-term ret. (6-12 years)	7.23		11.95	
Long-term retired (13^{+})	5.46		11.04	
High income	26.08		40.68	
Medium income	34.54		31.38	
Low income	31.50		22.09	
Income (missing)	7.88		5.85	
Physical functioning (SF36, 0-100)		87.15 (18.61)		89.92 (15.71)
Age: 40 - 49	20.69		12.91	
50 - 59	44.41		37.84	
60 - 69	24.33		29.57	
70 - 79	8.90		16.72	
80+	1.67		2.90	
NT (individual-year observations)	2,565		2,642	
N (individuals)	1,023		1,068	

Source: German Ageing Survey (DEAS). Authors' elaboration. Note: 1. Values refer to the empirical range and not to the theoretical possible range.

Table A2: Sample characteristics for the analysis of the grandchild care effect (*working sample 2)*, % or mean and standard deviation, by gender

	Women		Men	
	%	Mean (St.D.)	%	Mean (St.D.)
Number of regular activities (0-12) [1]		5.22 (2.04)		5.29 (1.96)
Number of frequent activities (0-8) [1]		2.56 (1.41)		2.68 (1.36)
Activities carried out with friends and others (0-6) [1]		1.28 (1.27)		0.96 (1.12)
At least one activity carried out with relatives (0;1)	11.00		6.69	
No grandchildren	48.74		41.44	
1 Grandchild	12.58		14.28	
2 Grandchildren	14.71		14.77	
3+ Grandchildren	23.97		29.51	
Provide grandchild care	4.71		4.57	
In a relationship	75.81		90.13	
Working	41.58		33.09	
Not working	12.48		5.66	
Short-term retired (0-5 years)	15.06		16.23	
Medium-term ret. (6-12 years)	13.13		18.55	
Long-term retired (13*)	17.74		26.47	
High income	28.94		34.81	
Medium income	34.13		33.92	
Low income	29.06		25.54	
Income (missing)	7.87		5.73	
Physical functioning (SF36, 0-100)		83.56 (21.11)		86.63 (18.68)
Age: 40 - 49	13.61		7.59	
50 - 59	31.29		23.62	
60 - 69	26.81		27.43	
70 - 79	22.42		31.93	
80+	5.87		9.44	
NT (individual-year observations)	2,565		2,642	
N (individuals)	1,023		1,068	

Source: German Ageing Survey (DEAS). Authors' elaboration. Note: 1. Values refer to the empirical range and not to the theoretical possible range.

Table A3: Sample characteristics for the analysis of the grandchild care effect (*working sample 3)*, % or mean and standard deviation, by gender

	Women		Men	
	%	Mean (St.D.)	%	Mean (St.D.)
Number of regular activities (0-12) [1]		5.26 (2.03)		5.35 (1.96)
Number of frequent activities (0-8) [1]		2.57 (1.41)		2.71 (1.37)
Activities carried out with friends and others (0-6) [1]		1.26 (1.26)		0.97 (1.12)
At least one activity carried out with relatives (0;1)	12.41		7.40	
No grandchildren	42.91		37.55	
1 Grandchild	13.65		14.82	
2 Grandchildren	16.22		15.78	
3+ Grandchildren	27.22		31.85	
Provide no grandchild care	84.54		86.91	
First transition into Grandchild care	9.25		8.08	
Cont. to provide care (over 2 waves)	5.13		3.97	
Cont. to provide care (over 3 waves)	1.07		1.04	
In a relationship	76.33		90.78	
Working	40.28		31.58	
Not working	13.17		5.85	
Short-term retired (0-5 years)	16.39		16.97	
Medium-term ret. (6-12 years)	13.82		19.39	
Long-term retired (13*)	16.33		26.22	
High income	28.55		34.33	
Medium income	33.82		33.76	
Low income	29.65		26.27	
Income (missing)	7.98		5.64	
Physical functioning (SF36, 0-100)		83.71 (20.77)		86.81 (18.33)
Age: 40 - 49	12.50		6.92	
50 - 59	31.57		22.99	
60 - 69	28.89		28.66	
70 - 79	21.86		32.51	
80+	5.19		8.92	
NT (individual-year observations)	2,565		2,642	
N (individuals)	1,023		1,068	

Source: German Ageing Survey (DEAS). Authors' elaboration. Note: 1. Values refer to the empirical range and not to the theoretical possible range.

Regression Models: Main Analysis

Table A4: Coefficients and Std. Err. of number of grandchildren on all outcome variables, from linear fixed-effects regression among **men** (Figure 2 in the Main Document).

	No. of regular activities		No. of frequent activities		Activities carried out with relatives		Activities carried out with friends or others	
	B	*S.E.*	*B*	*S.E.*	*B*	*S.E.*	*B*	*S.E.*
No Grandchildren	ref.		ref.		ref.		ref.	
1 Grandchild	-0.080	(0.172)	0.103	(0.127)	-0.005	(0.031)	-0.155	(0.134)
2 Grandchildren	-0.277	(0.218)	-0.410*	(0.171)	0.026	(0.040)	-0.089	(0.164)
3+ Grandchildren	-0.338	(0.253)	-0.370^{+}	(0.203)	0.065	(0.049)	-0.109	(0.191)
In relationship	-0.064	(0.214)	-0.135	(0.169)	-0.015	(0.032)	-0.319**	(0.118)
Employed	ref.		ref.		ref.		ref.	
Not-employed	0.649**	(0.215)	0.637***	(0.179)	0.059^{+}	(0.034)	-0.135	(0.146)
Not employed	0.243	(0.201)	0.319^{+}	(0.187)	0.028	(0.038)	-0.069	(0.161)
Short-term retired	0.135	(0.336)	0.129	(0.274)	0.076	(0.053)	-0.083	(0.245)
Medium-term retired	0.076	(0.451)	0.177	(0.347)	0.132*	(0.067)	-0.005	(0.315)
Physical functioning	0.006	(0.005)	0.006^{+}	(0.003)	0.001	(0.001)	0.002	(0.003)
High income	0.031	(0.200)	-0.195	(0.137)	-0.017	(0.032)	0.210	(0.133)
Medium income	0.165	(0.159)	-0.003	(0.114)	-0.022	(0.026)	0.116	(0.105)
Low income	ref.		ref.		ref.		ref.	
Missing	0.111	(0.253)	-0.048	(0.198)	-0.051	(0.035)	0.077	(0.174)
40 - 49 years	-0.250	(0.299)	-0.056	(0.231)	0.023	(0.060)	0.174	(0.206)
50 - 59 years	-0.309*	(0.154)	-0.204	(0.132)	-0.052^{+}	(0.031)	-0.019	(0.116)
60 - 69 years	ref.		ref.		ref.		ref.	
70 - 79 years	0.124	(0.248)	-0.404^{+}	(0.209)	-0.003	(0.025)	0.238	(0.154)
80 - 91 years	-0.343	(0.395)	-1.025**	(0.355)	0.020	(0.069)	0.068	(0.240)

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Table A4 (continued)

Interview y. 2002	-0.261	(0.225)	-0.405*	(0.167)	0.285***	(0.054)	0.158	(0.163)
Interview y. 2008	ref.		ref.		ref.		ref.	
Interview y. 2011	-0.059	(0.107)	0.124	(0.080)	-0.010	(0.016)	-0.056	(0.073)
Interview y. 2014	-0.612***	(0.137)	-0.151	(0.102)	-0.018	(0.022)	0.041	(0.102)
No. of regular Activities					0.002	(0.006)	0.112***	(0.025)
Constant	4.710***	(0.542)	2.088***	(0.431)	-0.004	(0.110)	0.565	(0.412)
R^2	0.094		0.096		0.092		0.043	
NT (N)	1657 (687)		1657 (687)		1657 (687)		1657 (687)	

B= Regression Coefficients, S.E.= Cluster robust standard errors. NT = no. of individual*year observations, N = no. of individuals.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A5: Coefficients and Std. Err. of number of grandchildren and grandchild care on all outcome variables, from linear fixed-effects regression among **men** (Figure 2 in the Main Document).

	No. of regular activities		No. of frequent activities		Activities carried out with relatives		Activities carried out with friends or others	
	B	*S.E.*	*B*	*S.E.*	*B*	*S.E.*	*B*	*S.E.*
No Grandchildren	ref.		ref.		ref.		ref.	
1 Grandchild	-0.085	(0.176)	0.102	(0.128)	-0.006	(0.031)	-0.154	(0.136)
2 Grandchildren	-0.289	(0.228)	-0.413*	(0.175)	0.022	(0.041)	-0.085	(0.170)
3+ Grandchildren	-0.357	(0.277)	-0.376^{+}	(0.220)	0.059	(0.050)	-0.103	(0.205)
Grandchild care	0.043	(0.194)	0.011	(0.163)	0.013	(0.035)	-0.014	(0.134)
In relationship	0.576	(0.360)	0.333	(0.290)	-0.033	(0.056)	-0.351	(0.244)
Employed	ref.		ref.		ref.		ref.	
Not employed	0.648**	(0.216)	0.637***	(0.180)	0.059^{+}	(0.034)	-0.134	(0.146)
Short-term retired	0.243	(0.201)	0.319^{+}	(0.187)	0.028	(0.038)	-0.069	(0.161)
Medium-term retired	0.135	(0.336)	0.129	(0.274)	0.076	(0.053)	-0.082	(0.245)
Long-term retired	0.078	(0.451)	0.177	(0.347)	0.133*	(0.067)	-0.006	(0.315)
Physical functioning	0.006	(0.005)	0.006^{+}	(0.003)	0.001	(0.001)	0.002	(0.003)
High income	0.032	(0.200)	-0.194	(0.137)	-0.017	(0.032)	0.210	(0.134)
Medium income	0.165	(0.160)	-0.003	(0.114)	-0.022	(0.026)	0.116	(0.106)
Low income	ref.		ref.		ref.		ref.	
Missing	0.111	(0.253)	-0.048	(0.198)	-0.051	(0.035)	0.077	(0.174)
40 - 49 years	-0.250	(0.299)	-0.056	(0.231)	0.023	(0.060)	0.174	(0.206)
50 - 59 years	-0.309*	(0.154)	-0.204	(0.132)	-0.052^{+}	(0.031)	-0.019	(0.116)
60 - 69 years	0.000	(.)	0.000	(.)	0.000	(.)	0.000	(.)
70 - 79 years	0.125	(0.248)	-0.403^{+}	(0.209)	-0.002	(0.025)	0.238	(0.155)
80 - 91 years	-0.340	(0.396)	-1.024**	(0.356)	0.021	(0.069)	0.067	(0.241)

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Table A5 (continued)

Interview y. 2002	-0.260	(0.224)	-0.405*	(0.167)	0.286***	(0.054)	0.158	(0.163)
Interview y. 2008	ref.		ref.		ref		ref	
Interview y. 2011	-0.060	(0.107)	0.124	(0.080)	-0.010	(0.016)	-0.056	(0.074)
Interview y. 2014	-0.614***	(0.137)	-0.152	(0.102)	-0.018	(0.023)	0.042	(0.102)
Number of regular activities					0.002	(0.006)	0.112***	(0.025)
Constant	4.711***	(0.540)	2.088***	(0.431)	-0.004	(0.110)	0.565	(0.412)
R^2	0.094		0.096		0.092		0.043	0.094
NT (N)	1657 (687)		1657 (687)		1657 (687)		1657 (687)	

B= Regression Coefficients, S.E.= Cluster robust standard errors. NT = no. of individual*year observations, N = no. of individuals.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A6: Coefficients and Std. Err. of number of grandchildren on all outcome variables, from linear fixed-effects regression among **women** (Figure 3 in the Main Document).

	No. of regular activities		No. of frequent activities		Activities carried out with relatives		Activities carried out with friends or others	
	B	*S.E.*	*B*	*S.E.*	*B*	*S.E.*	*B*	*S.E.*
No Grandchildren	ref.		ref.		ref		ref	
1 Grandchild	-0.033	(0.156)	-0.065	(0.127)	0.090*	(0.041)	0.107	(0.120)
2 Grandchildren	-0.090	(0.212)	-0.024	(0.171)	0.066	(0.048)	0.075	(0.156)
3+ Grandchildren	0.165	(0.273)	0.411^{+}	(0.218)	0.074	(0.059)	-0.036	(0.206)
In relationship	0.053	(0.199)	-0.025	(0.174)	-0.024	(0.042)	-0.475**	(0.167)
Employed	ref.		ref.		ref		ref	
Not-employed	0.448**	(0.168)	0.423**	(0.150)	0.026	(0.030)	-0.258^{+}	(0.136)
Retired	0.708***	(0.193)	0.552**	(0.182)	-0.038	(0.037)	-0.283*	(0.143)
Medium-term retired	0.707*	(0.317)	0.066	(0.252)	-0.105^{+}	(0.059)	-0.467*	(0.217)
Long-term retired	0.649	(0.468)	-0.212	(0.377)	-0.060	(0.089)	-0.410	(0.312)
Physical functioning	0.003	(0.003)	0.005^{+}	(0.003)	-0.001	(0.001)	-0.002	(0.002)
High income	-0.005	(0.151)	-0.087	(0.130)	0.034	(0.036)	0.076	(0.117)
Medium income	0.090	(0.125)	-0.093	(0.111)	-0.003	(0.032)	0.095	(0.101)
Low income	0.000	(.)	0.000	(.)	0.000	(.)	0.000	(.)
Missing	0.161	(0.190)	-0.124	(0.166)	0.049	(0.048)	0.120	(0.146)
40 - 49 years	0.124	(0.235)	-0.019	(0.193)	0.070	(0.055)	-0.085	(0.180)
50 - 59 years	0.081	(0.146)	0.081	(0.123)	0.039	(0.033)	-0.086	(0.111)
60 - 69 years	0.000	(.)	0.000	(.)	0.000	(.)	0.000	(.)
70 - 79 years	-0.079	(0.213)	-0.008	(0.173)	0.064	(0.048)	-0.019	(0.135)
80 - 91 years	-0.505	(0.425)	-0.373	(0.355)	0.354**	(0.126)	-0.626*	(0.267)

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Table A6 (continued)

Interview y. 2002	0.186	(0.174)	-0.257^{+}	(0.147)	0.273***	(0.051)	0.231	(0.142)
Interview y. 2008	ref.		ref.		ref		ref	
Interview y. 2011	0.035	(0.091)	0.211**	(0.074)	0.033^{+}	(0.019)	-0.023	(0.072)
Interview y. 2014	-0.554***	(0.116)	-0.105	(0.095)	0.018	(0.026)	0.210*	(0.093)
Number of regular activities					0.009	(0.007)	0.157***	(0.023)
Constant	5.003***	(0.356)	2.085***	(0.308)	0.047	(0.090)	1.175***	(0.266)
R^2	0.081		0.066		0.076		0.068	
NT (N)	1977 (816)		1977 (816)		1977 (816)		1977 (816)	

B= Regression Coefficients, S.E.= Cluster robust standard errors. NT = no. of individual*year observations, N = no. of individuals.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A7: Coefficients and Std. Err. of number of grandchildren on all outcome variables, from linear fixed-effects regression among **women** (Figure 3 in the Main Document).

	No. of regular activities		No. of frequent activities		Activities carried out with relatives		Activities carried out with friends or others	
	B	*S.E.*	*B*	*S.E.*	*B*	*S.E.*	*B*	*S.E.*
No Grandchildren	0.000		0.000		0.000		0.000	
1 Grandchild	-0.112	(0.157)	-0.081	(0.136)	0.084*	(0.040)	0.082	(0.123)
2 Grandchildren	-0.202	(0.218)	-0.047	(0.181)	0.057	(0.050)	0.041	(0.160)
3+ Grandchildren	0.029	(0.280)	0.383^{+}	(0.227)	0.063	(0.062)	-0.078	(0.207)
Grandchild care	0.272	(0.176)	0.055	(0.150)	0.023	(0.042)	0.084	(0.132)
In relationship	0.039	(0.199)	-0.028	(0.174)	-0.025	(0.042)	-0.479**	(0.167)
Employed	ref.		ref.		ref		ref	
Not-employed	0.455**	(0.169)	0.424**	(0.150)	0.027	(0.030)	-0.256^{+}	(0.137)
Short-term retired	0.698***	(0.195)	0.550**	(0.183)	-0.039	(0.038)	-0.285*	(0.143)
Medium-term retired	0.697*	(0.317)	0.064	(0.252)	-0.106^{+}	(0.059)	-0.470*	(0.218)
Long-term retired	0.649	(0.469)	-0.212	(0.377)	-0.060	(0.090)	-0.410	(0.312)
Physical functioning	0.003	(0.003)	0.005^{+}	(0.003)	-0.001	(0.001)	-0.002	(0.002)
High income	-0.007	(0.151)	-0.087	(0.130)	0.034	(0.036)	0.076	(0.117)
Medium income	0.077	(0.126)	-0.096	(0.112)	-0.004	(0.032)	0.091	(0.102)
Low income	ref.		ref.		ref		ref	
Missing	0.159	(0.189)	-0.124	(0.166)	0.049	(0.048)	0.119	(0.146)
40 - 49 years	0.127	(0.235)	-0.018	(0.193)	0.071	(0.055)	-0.084	(0.180)
50 - 59 years	0.084	(0.146)	0.081	(0.123)	0.039	(0.033)	-0.085	(0.111)
60 - 69 years	ref.		ref.		ref		ref	
70 - 79 years	-0.075	(0.213)	-0.007	(0.173)	0.064	(0.048)	-0.017	(0.135)
80 - 91 years	-0.492	(0.425)	-0.371	(0.354)	0.355**	(0.126)	-0.623*	(0.268)

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Table A7 (continued)

Interview y. 2002	0.190	(0.174)	-0.256^{+}	(0.147)	0.273***	(0.051)	0.232	(0.142)
Interview y. 2008	ref.		ref.		ref		ref	
Interview y. 2011	0.034	(0.091)	0.211**	(0.074)	0.033^{+}	(0.019)	-0.024	(0.072)
Interview y. 2014	-0.557***	(0.116)	-0.106	(0.095)	0.017	(0.026)	0.209*	(0.093)
Number of regular activities					0.009	(0.007)	0.156***	(0.023)
Constant	5.014***	(0.356)	2.087***	(0.308)	0.049	(0.090)	1.182***	(0.266)
R^2	0.084		0.066		0.076		0.068	
NT (N)	1977 (816)		1977 (816)		1977 (816)		1977 (816)	

B= Regression Coefficients, S.E.= Cluster robust standard errors. NT = no. of individual*year observations, N = no. of individuals.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A8: Coefficients and Std. Err. of number of grandchildren and grandchild care on all outcome variables, from linear fixed-effects regression among **men** (Figure 4 (A) in Main Document).

	No. of regular activities		No. of frequent activities		Activities carried out with relatives		Activities carried out with friends or others	
	B	*S.E.*	*B*	*S.E.*	*B*	*S.E.*	*B*	*S.E.*
No Grandchildren	ref.		ref.		ref		ref	
1 Grandchild	0.090	(0.151)	0.185^{+}	(0.113)	0.033	(0.028)	-0.140	(0.117)
2 Grandchildren	0.050	(0.179)	-0.128	(0.136)	0.028	(0.034)	-0.015	(0.132)
3+ Grandchildren	-0.076	(0.204)	-0.143	(0.156)	0.063^{+}	(0.037)	-0.112	(0.153)
Grandchild care	0.259^{+}	(0.156)	0.245^{+}	(0.126)	0.009	(0.032)	0.133	(0.100)
In relationship	0.124	(0.226)	0.032	(0.179)	-0.021	(0.032)	-0.334*	(0.140)
Employed	0.000	(.)	0.000	(.)	0.000	(.)	0.000	(.)
Not-employed	0.692***	(0.185)	0.688***	(0.152)	0.051	(0.033)	-0.294*	(0.132)
Short-term retired	0.509**	(0.164)	0.599***	(0.151)	-0.020	(0.034)	-0.146	(0.124)
Medium-term retired	0.525*	(0.246)	0.514*	(0.207)	0.037	(0.047)	-0.197	(0.172)
Long-term retired	0.600^{+}	(0.313)	0.489^{+}	(0.252)	0.057	(0.055)	-0.117	(0.209)
Physical functioning	0.008**	(0.003)	0.007***	(0.002)	0.000	(0.001)	0.003*	(0.002)
High income	0.037	(0.142)	-0.156	(0.105)	-0.030	(0.025)	0.131	(0.089)
Medium income	0.149	(0.107)	-0.009	(0.082)	-0.011	(0.019)	0.063	(0.067)
Low income	ref.		ref.		ref		ref	
Missing	0.175	(0.176)	0.025	(0.141)	-0.010	(0.032)	0.154	(0.114)
40 - 49 years	-0.339	(0.268)	-0.138	(0.202)	0.070	(0.057)	0.036	(0.179)
50 - 59 years	-0.282*	(0.137)	-0.164	(0.115)	-0.014	(0.028)	-0.107	(0.100)
60 - 69 years	ref.		ref.		ref		ref	
70 - 79 years	0.025	(0.160)	-0.180	(0.131)	-0.047^{+}	(0.026)	0.164^{+}	(0.093)
80 - 91 years	-0.244	(0.235)	-0.532**	(0.189)	-0.016	(0.037)	0.201	(0.134)

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Table A8 (continued)

Interview y. 2002	-0.077	(0.150)	-0.226*	(0.112)	0.256***	(0.035)	0.194+	(0.101)
Interview y. 2008	ref.		ref.		ref		ref	
Interview y. 2011	-0.212**	(0.076)	-0.002	(0.055)	-0.011	(0.011)	-0.020	(0.051)
Interview y. 2014	-0.850***	(0.101)	-0.365***	(0.076)	-0.014	(0.018)	0.048	(0.073)
Number of regular activities					0.004	(0.004)	0.114***	(0.017)
Constant	4.469***	(0.364)	2.010***	(0.291)	0.015	(0.072)	0.391	(0.240)
R^2	0.107		0.095		0.092		0.047	
NT (N)	3019 (1262)		3019 (1262)		3019 (1262)		3019 (1262)	

B= Regression Coefficients, S.E.= Cluster robust standard errors. NT = no. of individual*year observations, N = no. of individuals.
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A9: Coefficients and Std. Err. of number of grandchildren and grandchild care on all outcome variables, from linear fixed-effects regression among **women** (Figure 5 (A) in Main Document).

	No. of regular activities		No. of frequent activities		Activities carried out with relatives		Activities carried out with friends or others	
	B	*S.E.*	*B*	*S.E.*	*B*	*S.E.*	*B*	*S.E.*
No Grandchildren	ref.		ref.		ref		ref	
1 Grandchild	0.039	(0.151)	0.011	(0.124)	0.067^{+}	(0.038)	0.090	(0.121)
2 Grandchildren	-0.163	(0.189)	-0.025	(0.152)	0.067	(0.041)	0.046	(0.141)
3+ Grandchildren	0.115	(0.238)	0.493**	(0.178)	0.094^{+}	(0.053)	0.019	(0.169)
Grandchild care	0.238	(0.163)	-0.100	(0.135)	0.011	(0.039)	0.152	(0.113)
In relationship	-0.114	(0.173)	-0.101	(0.135)	0.025	(0.029)	-0.551***	(0.119)
Employed	ref.		ref.		ref		ref	
Not-employed	0.415**	(0.149)	0.509***	(0.131)	-0.002	(0.028)	-0.160	(0.111)
Short-term retired	0.516**	(0.167)	0.535***	(0.145)	-0.042	(0.030)	-0.177	(0.111)
Medium-term retired	0.614*	(0.240)	0.372^{+}	(0.197)	-0.023	(0.046)	-0.315*	(0.160)
Long-term retired	0.406	(0.318)	0.110	(0.253)	-0.017	(0.059)	-0.321	(0.208)
Physical functioning	0.008***	(0.002)	0.006**	(0.002)	-0.001	(0.000)	0.001	(0.001)
High income	0.114	(0.126)	0.044	(0.104)	0.033	(0.029)	0.136	(0.089)
Medium income	0.071	(0.097)	-0.009	(0.085)	0.013	(0.025)	0.071	(0.070)
Low income	ref.		ref.		ref		ref	
Missing	0.294*	(0.141)	0.048	(0.123)	0.033	(0.033)	0.050	(0.103)
40 - 49 years	0.014	(0.212)	-0.212	(0.173)	0.030	(0.049)	-0.084	(0.161)
50 - 59 years	-0.094	(0.124)	-0.127	(0.106)	0.003	(0.028)	-0.017	(0.096)
60 - 69 years	ref.		ref.		ref		ref	
70 - 79 years	-0.103	(0.134)	-0.188	(0.114)	-0.028	(0.028)	0.102	(0.093)
80 - 91 years	-0.275	(0.242)	-0.422*	(0.200)	0.078	(0.053)	-0.099	(0.151)

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Table A9 (continued)

Interview y. 2002	0.331*	(0.143)	-0.048	(0.114)	0.256***	(0.040)	0.238*	(0.104)
Interview y. 2008	ref.		ref.		ref		ref	
Interview y. 2011	0.016	(0.072)	0.129*	(0.059)	0.010	(0.015)	0.023	(0.053)
Interview y. 2014	-0.587***	(0.093)	-0.200**	(0.076)	-0.001	(0.021)	0.151*	(0.070)
Number of regular activities					0.007	(0.005)	0.159***	(0.017)
Constant	4.457***	(0.306)	1.969***	(0.240)	0.030	(0.066)	0.783***	(0.199)
R^2	0.095		0.069		0.065		0.074	
NT (N)	3100 (1285)		3100 (1285)		3100 (1285)		3100 (1285)	

B= Regression Coefficients, S.E.= Cluster robust standard errors. NT = no. of individual*year observations, N = no. of individuals.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A10: Coefficients and Std. Err. of number of grandchildren and grandchild care on all outcome variables, from linear fixed-effects regression among **men** (Figure 4 (B) in Main Document).

	No. of regular activities		No. of frequent activities		Activities carried out with relatives		Activities carried out with friends or others	
	B	*S.E.*	*B*	*S.E.*	*B*	*S.E.*	*B*	*S.E.*
No Grandchildren	ref.		ref.		ref		ref	
1 Grandchild	0.066	(0.145)	0.177	(0.108)	0.022	(0.027)	-0.120	(0.114)
2 Grandchildren	-0.001	(0.169)	-0.175	(0.129)	0.057^{+}	(0.033)	-0.052	(0.128)
3+ Grandchildren	-0.066	(0.193)	-0.140	(0.147)	0.096**	(0.036)	-0.114	(0.144)
First transition into Grandchild care	0.261^{+}	(0.140)	0.170	(0.110)	0.034	(0.030)	0.048	(0.092)
Cont. to provide care (over 2 waves)	0.036	(0.191)	-0.090	(0.162)	-0.042	(0.049)	0.086	(0.129)
Cont. to provide care (over 3 waves)	0.283	(0.335)	0.244	(0.251)	-0.112	(0.072)	0.039	(0.201)
In relationship	0.158	(0.218)	0.051	(0.171)	-0.022	(0.031)	-0.324*	(0.133)
Employed	ref.		ref.		ref		ref	
Not-employed	0.652***	(0.171)	0.686***	(0.143)	0.045	(0.032)	-0.304*	(0.123)
Short-term retired	0.556***	(0.157)	0.596***	(0.140)	-0.011	(0.035)	-0.154	(0.117)
Medium-term retired	0.587*	(0.230)	0.532**	(0.191)	0.020	(0.047)	-0.233	(0.161)
Long-term retired	0.609*	(0.292)	0.477*	(0.235)	0.038	(0.054)	-0.197	(0.197)
Physical functioning	0.008**	(0.003)	0.008***	(0.002)	0.000	(0.001)	0.003^{+}	(0.001)
High income	0.066	(0.135)	-0.083	(0.102)	-0.022	(0.025)	0.124	(0.086)
Medium income	0.162	(0.102)	0.041	(0.079)	-0.009	(0.019)	0.069	(0.064)
Low income	ref.		ref.		ref		ref	
Missing	0.188	(0.165)	0.077	(0.134)	-0.001	(0.030)	0.172	(0.109)

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Table A10 (continued)

40 - 49 years	-0.417	(0.255)	-0.155	(0.194)	0.073	(0.056)	0.145	(0.172)
50 - 59 years	-0.324*	(0.126)	-0.158	(0.107)	-0.007	(0.029)	-0.020	(0.096)
60 - 69 years	ref.		ref.		ref		ref	
70 - 79 years	0.145	(0.143)	-0.130	(0.119)	-0.056*	(0.025)	0.158^{+}	(0.086)
80 - 91 years	-0.051	(0.217)	-0.423*	(0.176)	-0.006	(0.037)	0.182	(0.125)
Interview year 2002	-0.047	(0.143)	-0.246*	(0.108)	0.271***	(0.034)	0.122	(0.096)
Interview y. 2008	ref.		ref.		ref		ref	
Interview y. 2011	-0.228**	(0.073)	0.002	(0.053)	-0.009	(0.011)	-0.009	(0.049)
Interview y. 2014	-0.883***	(0.097)	-0.374***	(0.074)	-0.008	(0.017)	0.074	(0.071)
Number of regular activities					0.006	(0.004)	0.110***	(0.016)
Constant	4.401***	(0.349)	1.928***	(0.274)	-0.003	(0.071)	0.451*	(0.228)
R^2	0.111		0.096		0.097		0.042	
NT (N)	3353 (1395)		3353 (1395)		3353 (1395)		3353 (1395)	

B= Regression Coefficients, S.E.= Cluster robust standard errors. NT = no. of individual*year observations, N = no. of individuals.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A11: Coefficients and Std. Err. of number of grandchildren and grandchild care on all outcome variables, from linear fixed-effects regression among **women** (Figure 5 (B) in Main Document).

	No. of regular activities		No. of frequent activities		Activities carried out with relatives		Activities carried out with friends or others	
	B	*S.E.*	*B*	*S.E.*	*B*	*S.E.*	*B*	*S.E.*
No Grandchildren	ref.		ref.		ref		ref	
1 Grandchild	0.058	(0.143)	0.047	(0.118)	0.083*	(0.037)	0.139	(0.114)
2 Grandchildren	-0.156	(0.174)	-0.044	(0.140)	0.080*	(0.040)	0.011	(0.132)
3+ Grandchildren	0.185	(0.218)	0.449**	(0.169)	0.114*	(0.050)	-0.009	(0.152)
Provide no grandchild care	ref.		ref.		ref		ref	
First transition into Grandchild care	0.145	(0.137)	-0.106	(0.116)	0.021	(0.034)	0.127	(0.096)
Cont. to provide care (over 2 waves)	0.085	(0.193)	-0.208	(0.155)	-0.061	(0.047)	0.106	(0.128)
Cont. to provide care (over 3 waves)	0.241	(0.334)	-0.073	(0.257)	0.137	(0.087)	-0.024	(0.200)
In relationship	-0.186	(0.160)	-0.077	(0.123)	0.017	(0.030)	-0.520***	(0.109)
Employed	ref.		ref.		ref		ref	
Not-employed	0.369**	(0.139)	0.457***	(0.118)	-0.022	(0.027)	-0.153	(0.100)
Short-term retired	0.441**	(0.155)	0.501***	(0.131)	-0.058^{+}	(0.031)	-0.170	(0.104)
Medium-term retired	0.467*	(0.220)	0.330^{+}	(0.179)	-0.021	(0.046)	-0.321*	(0.147)
Long-term retired	0.289	(0.294)	0.072	(0.232)	-0.014	(0.059)	-0.348^{+}	(0.192)
Physical functioning	0.008**	(0.002)	0.005**	(0.002)	-0.000	(0.000)	0.000	(0.001)
High income	0.083	(0.119)	0.023	(0.098)	0.042	(0.028)	0.053	(0.083)
Medium income	0.049	(0.091)	-0.043	(0.079)	0.009	(0.024)	0.040	(0.066)
Low income	ref.		ref.		ref		ref	
Missing	0.231^{+}	(0.131)	0.008	(0.118)	0.047	(0.032)	0.007	(0.096)

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Table A11 (continued)

40 - 49 years	-0.032	(0.198)	-0.198	(0.161)	0.031	(0.049)	-0.074	(0.150)
50 - 59 years	-0.067	(0.114)	-0.072	(0.098)	0.006	(0.028)	-0.023	(0.088)
60 - 69 years	0.000	(.)	0.000	(.)	0.000	(.)	0.000	(.)
70 - 79 years	-0.096	(0.127)	-0.152	(0.105)	-0.029	(0.029)	0.142^{+}	(0.086)
80 - 91 years	-0.262	(0.235)	-0.375^{+}	(0.191)	0.085	(0.052)	-0.090	(0.146)
Interview y. 2002	0.309*	(0.136)	-0.070	(0.107)	0.288***	(0.038)	0.261**	(0.099)
Interview y. 2008	0.000	(.)	0.000	(.)	0.000	(.)	0.000	(.)
Interview y. 2011	0.021	(0.069)	0.116*	(0.055)	0.011	(0.015)	0.028	(0.050)
Interview y. 2014	-0.602***	(0.090)	-0.215**	(0.073)	0.000	(0.021)	0.145*	(0.067)
Number of regular activities					0.007	(0.005)	0.157***	(0.016)
Constant	4.615***	(0.292)	2.013***	(0.225)	0.021	(0.067)	0.834***	(0.189)
R^2	0.089		0.063		0.081		0.073	
NT (N)	3545 (1467)		3545 (1467)		3545 (1467)		3545 (1467)	

B= Regression Coefficients, S.E.= Cluster robust standard errors. NT = no. of individual*year observations, N = no. of individuals.
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Robustness checks: Rotating the activities in the outcome

The grandparenthood effect (working sample 1)

Figure A1: Coefficients and 95% confidence intervals of **number of grandchildren** on number of regular activities (left panel) and number of frequent activities" (right panel), from linear fixed-effects regression among **men**

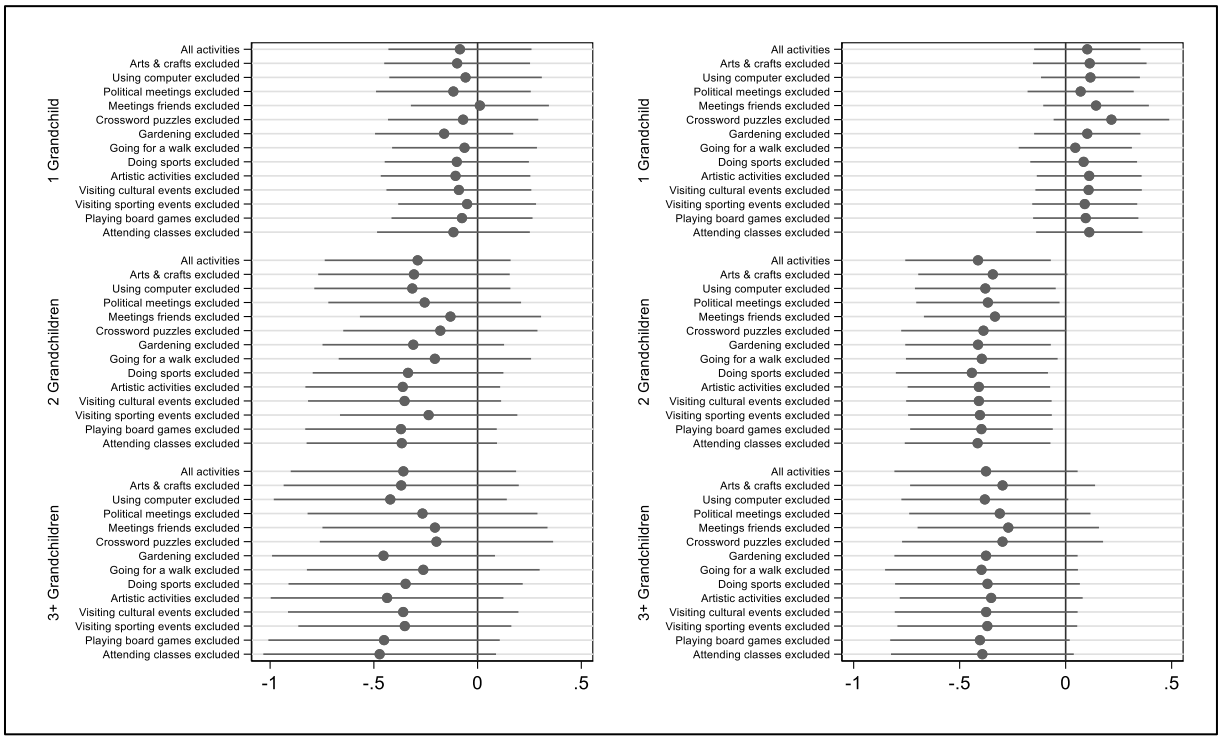


Figure A2: Coefficients and 95% confidence intervals of **number of grandchildren** on doing at least one activity with relatives (left panel) and number of activities done with friends or others (right panel), from linear fixed-effects regression among **men**

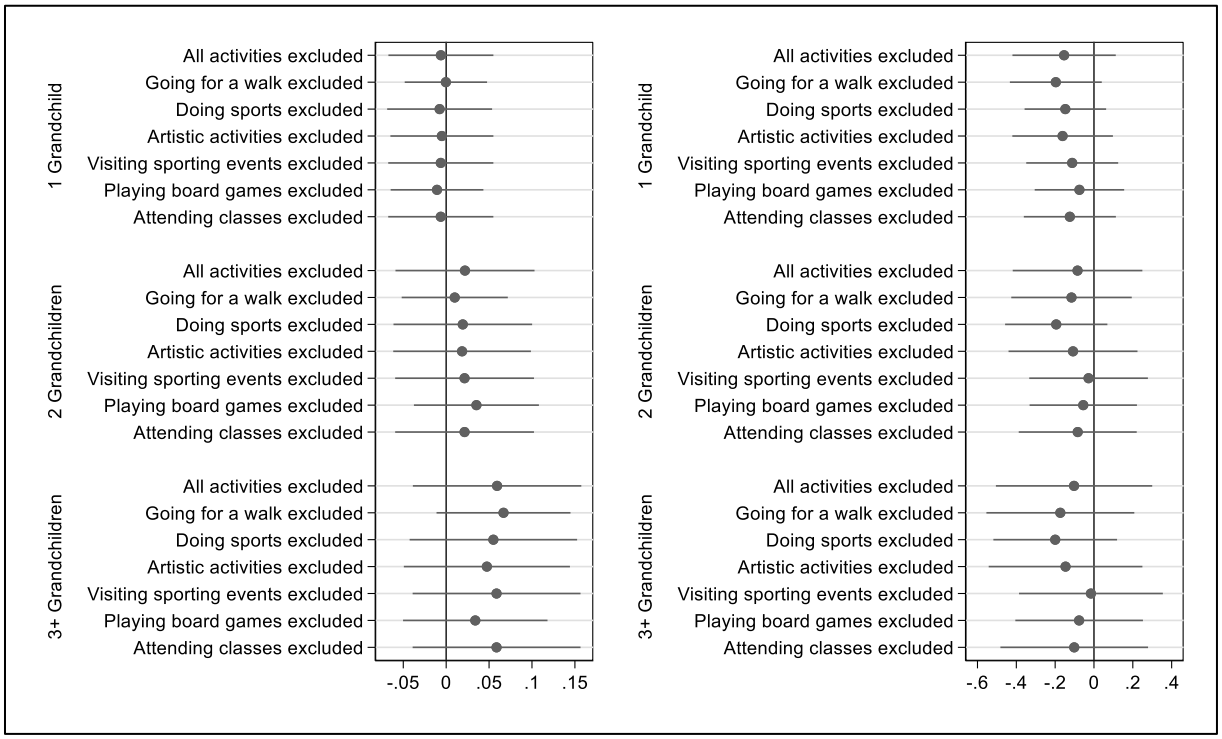


Figure A3: Coefficients and 95% confidence intervals of **number of grandchildren** on number of regular activities (left panel) and number of frequent activities (right panel), from linear fixed-effects regression among **women**

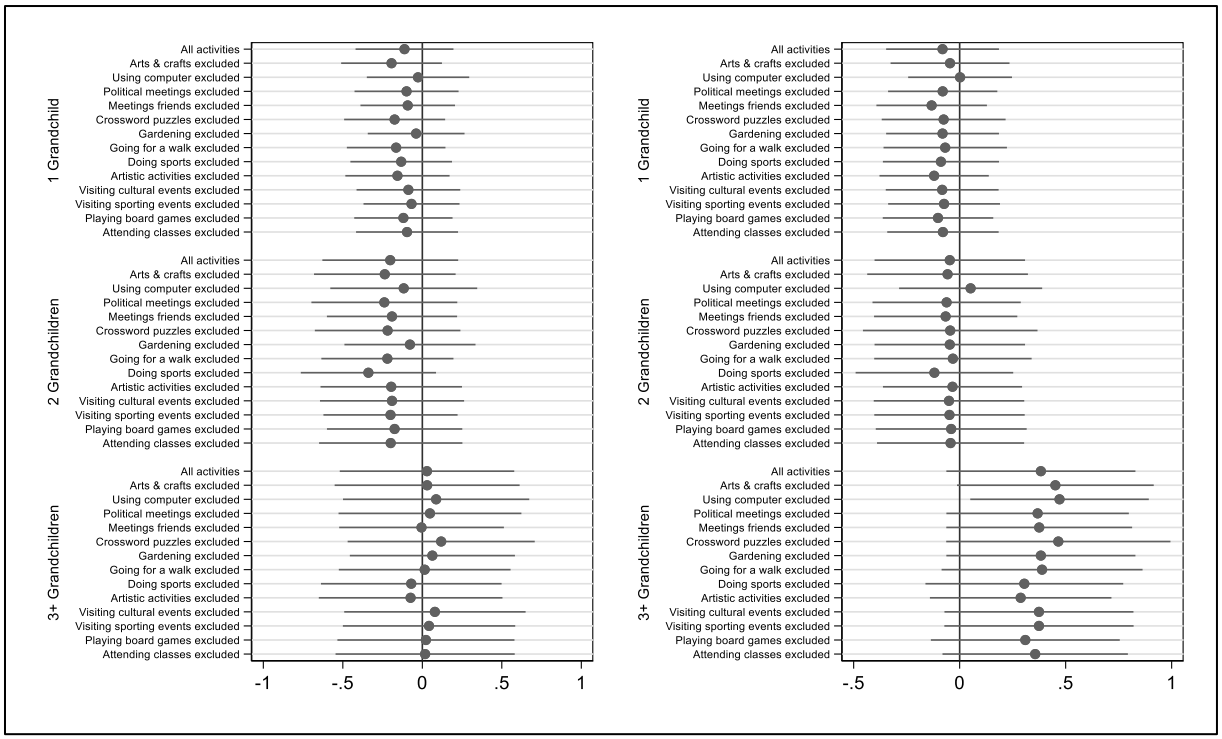
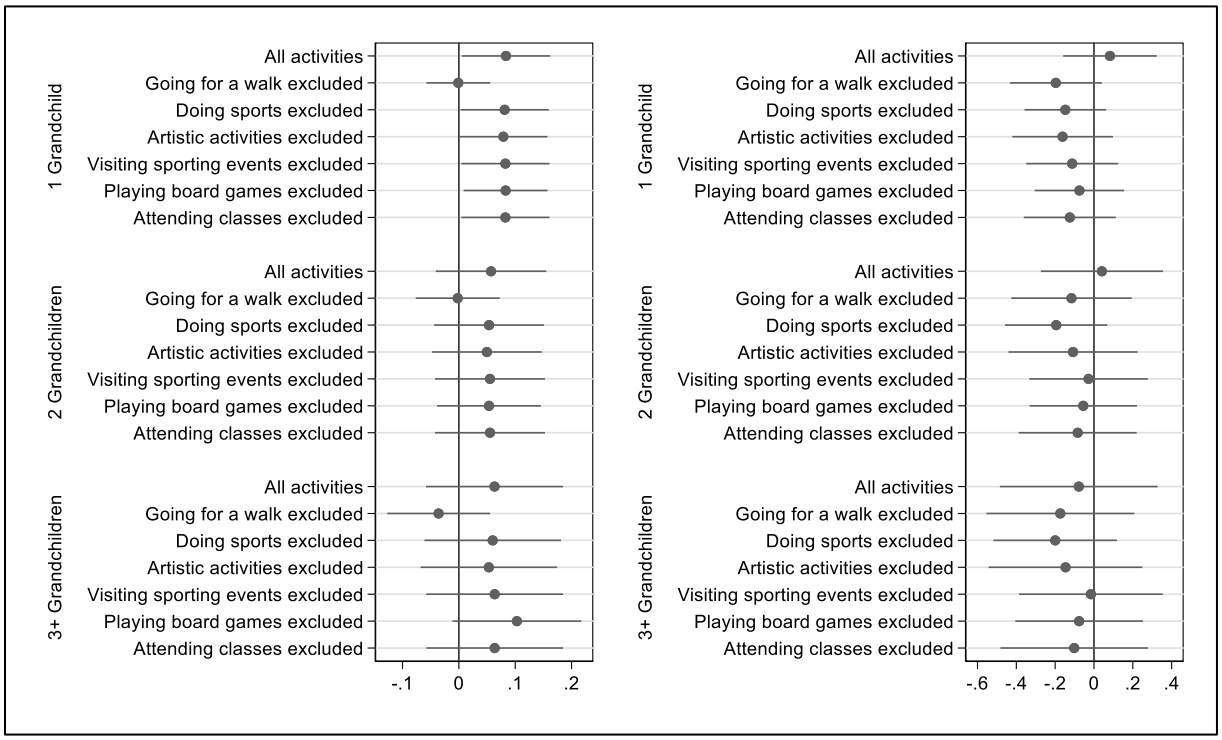


Figure A4: Coefficients and 95% confidence intervals of **number of grandchildren** on doing at least one activity with relatives (left panel) and number of activities done with friends or others (right panel), from linear fixed-effects regression among **women**



The grandchild care effect (working sample 2)

Figure A5: Coefficients and 95% confidence intervals of **grandchild care** on number of regular activities (left panel) and number of frequent activities" (right panel), from linear fixed-effects regression among **men**

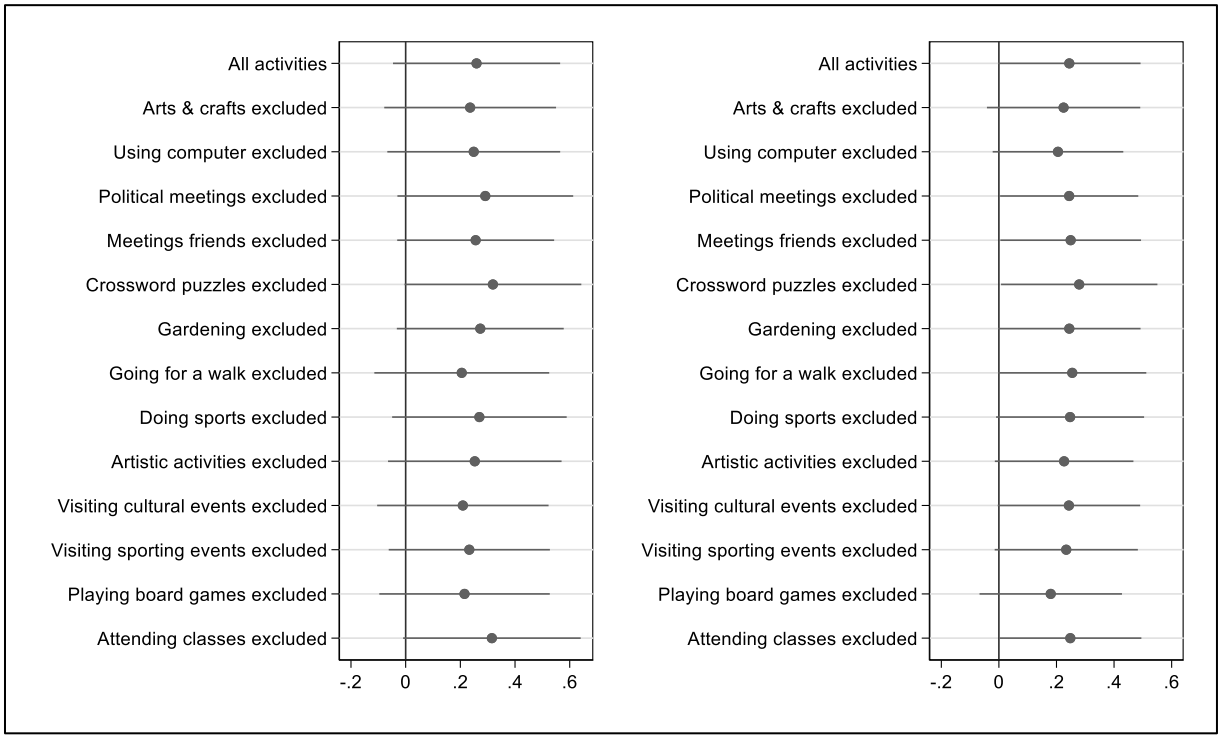


Figure A6: Coefficients and 95% confidence intervals of **grandchild care** on doing at least one activity with relatives (left panel) and number of activities done with friends or others (right panel), from linear fixed-effects regression among **men**

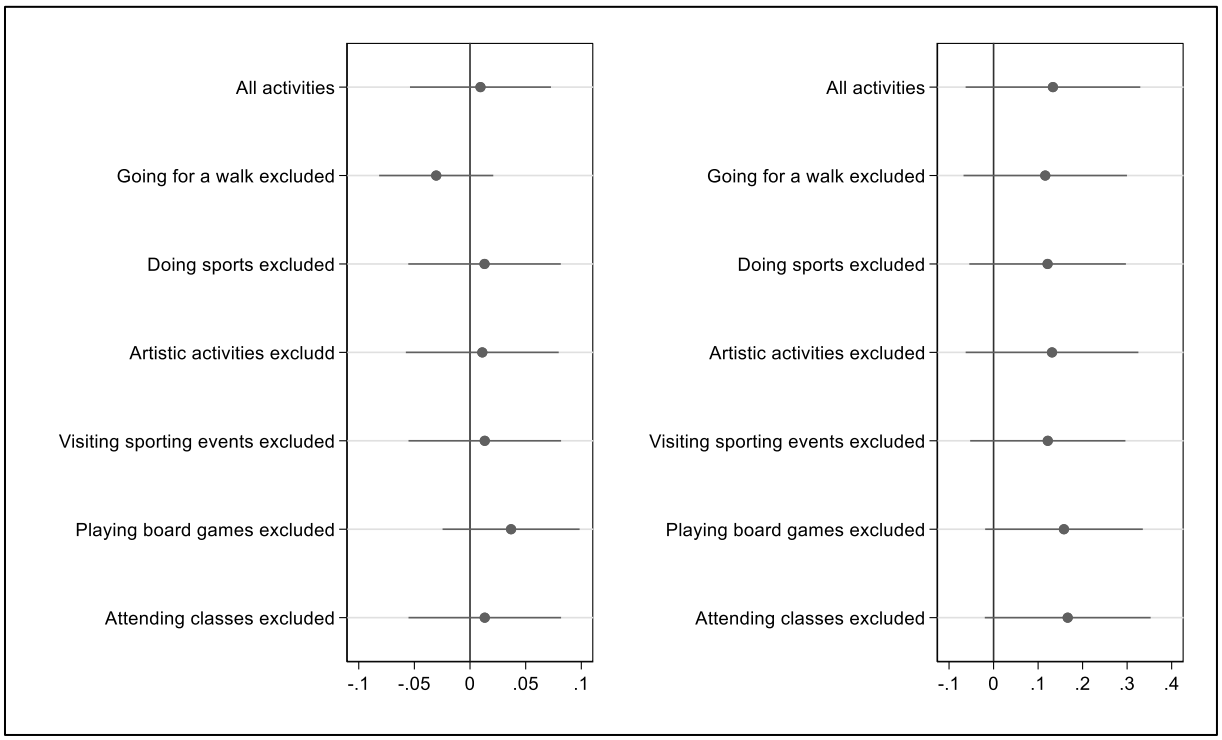


Figure A7: Coefficients and 95% confidence intervals of **grandchild care** on number of regular activities (left panel) and number of frequent activities" (right panel), from linear fixed-effects regression among **women**

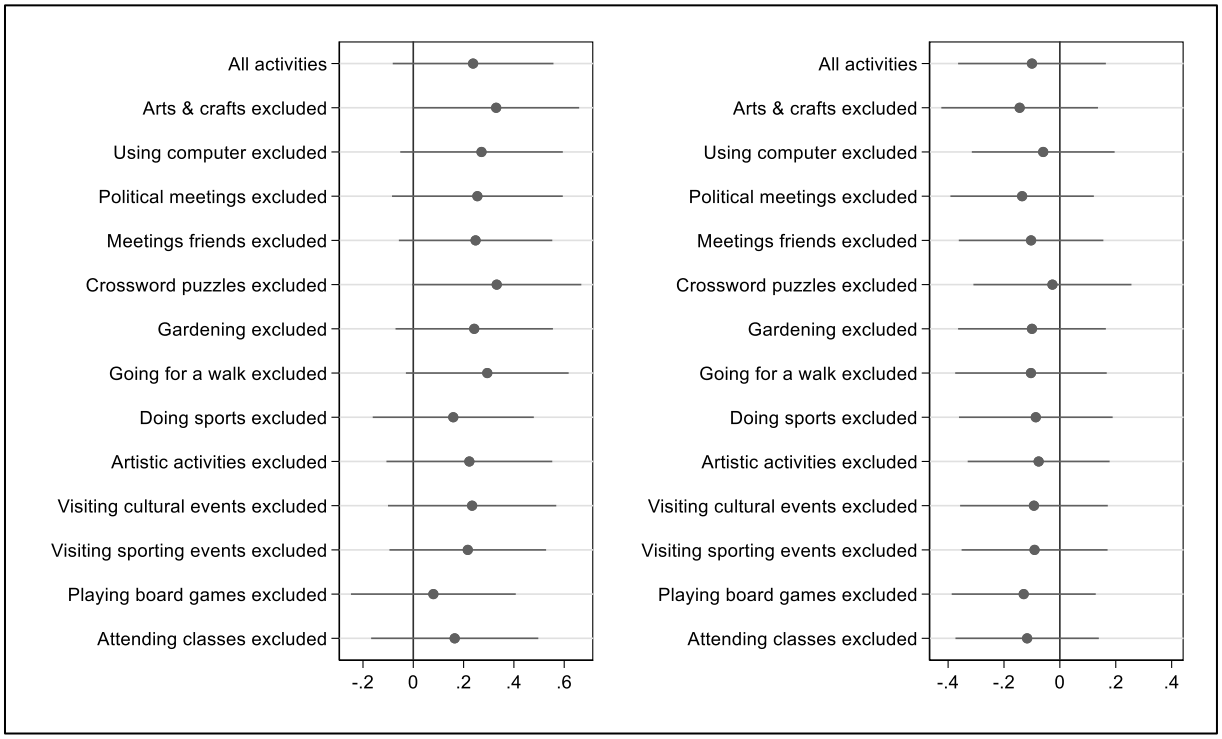


Figure A8: Coefficients and 95% confidence intervals of **grandchild care** on doing at least one activity with relatives (left panel) and number of activities done with friends or others (right panel), from linear fixed-effects regression among **women**

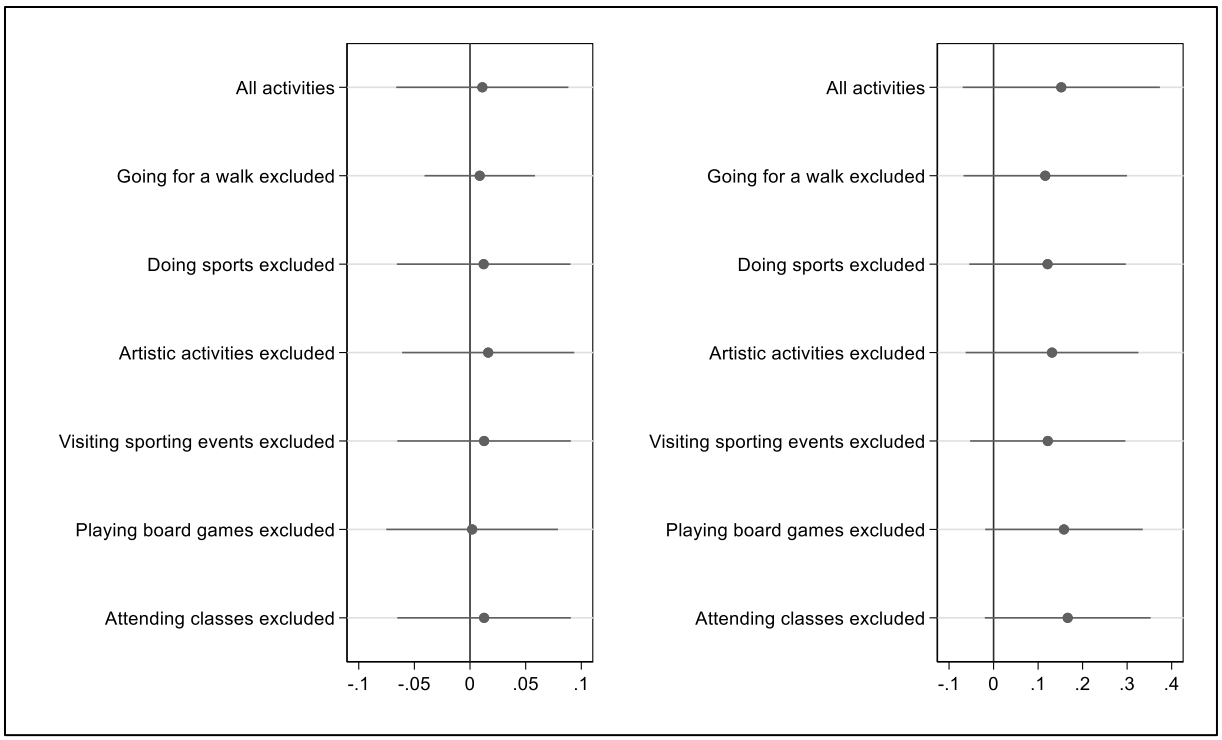


Figure A9: Coefficients and 95% confidence intervals of **grandchild care** on number of regular activities (left panel) and number of frequent activities" (right panel), from linear fixed-effects regression among **men**

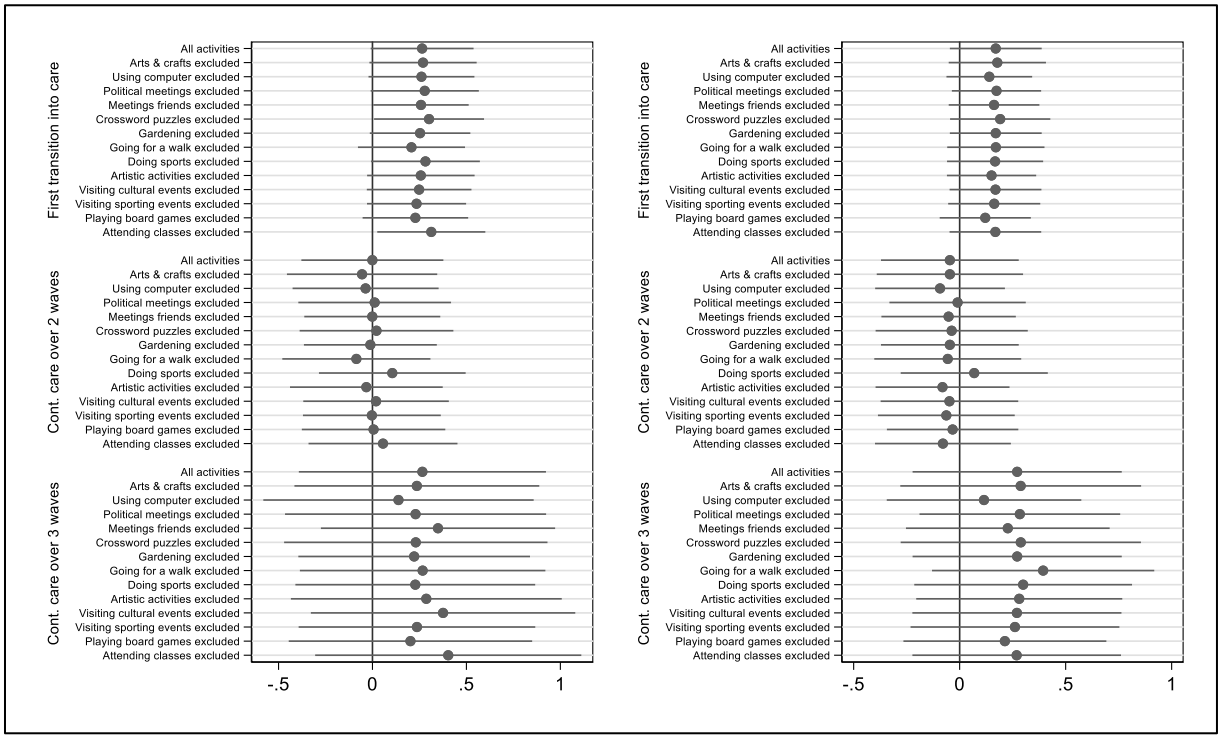


Figure A10: Coefficients and 95% confidence intervals of **grandchild care** on doing at least one activity with relatives (left panel) and number of activities done with friends or others (right panel), from linear fixed-effects regression among **men**

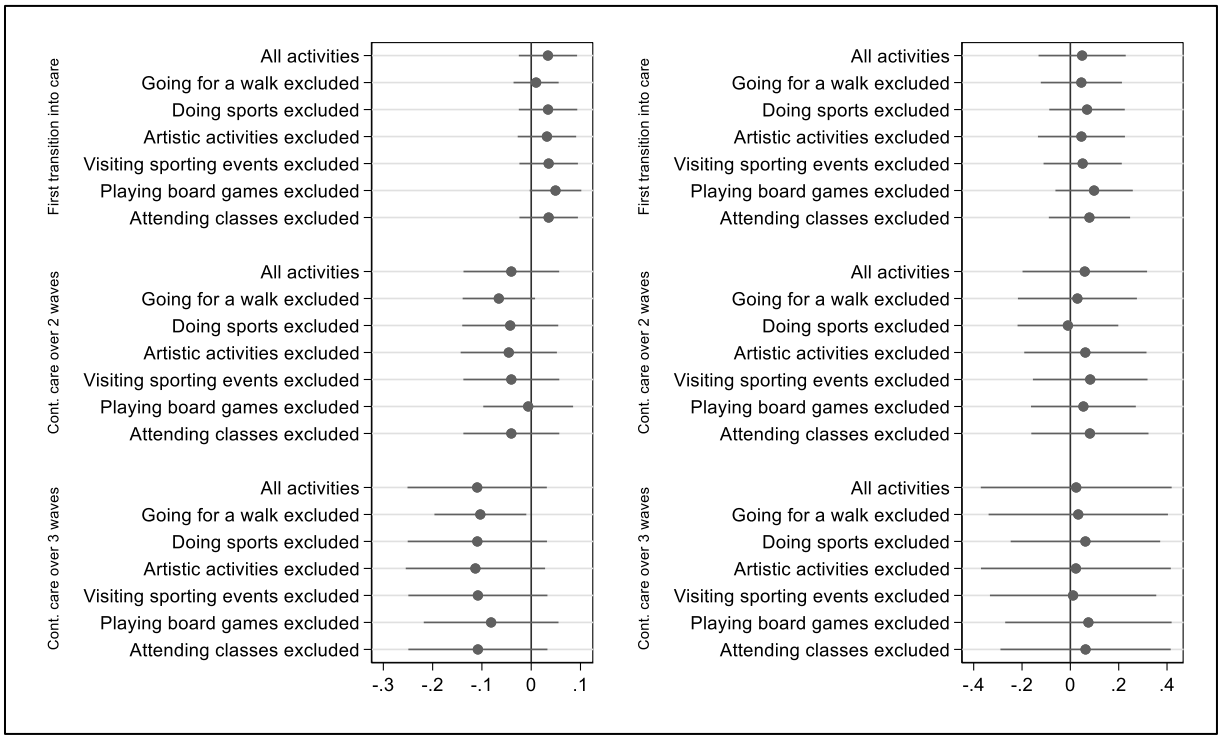


Figure A11: Coefficients and 95% confidence intervals of **grandchild care** on number of regular activities (left panel) and number of frequent activities" (right panel), from linear fixed-effects regression among **women**

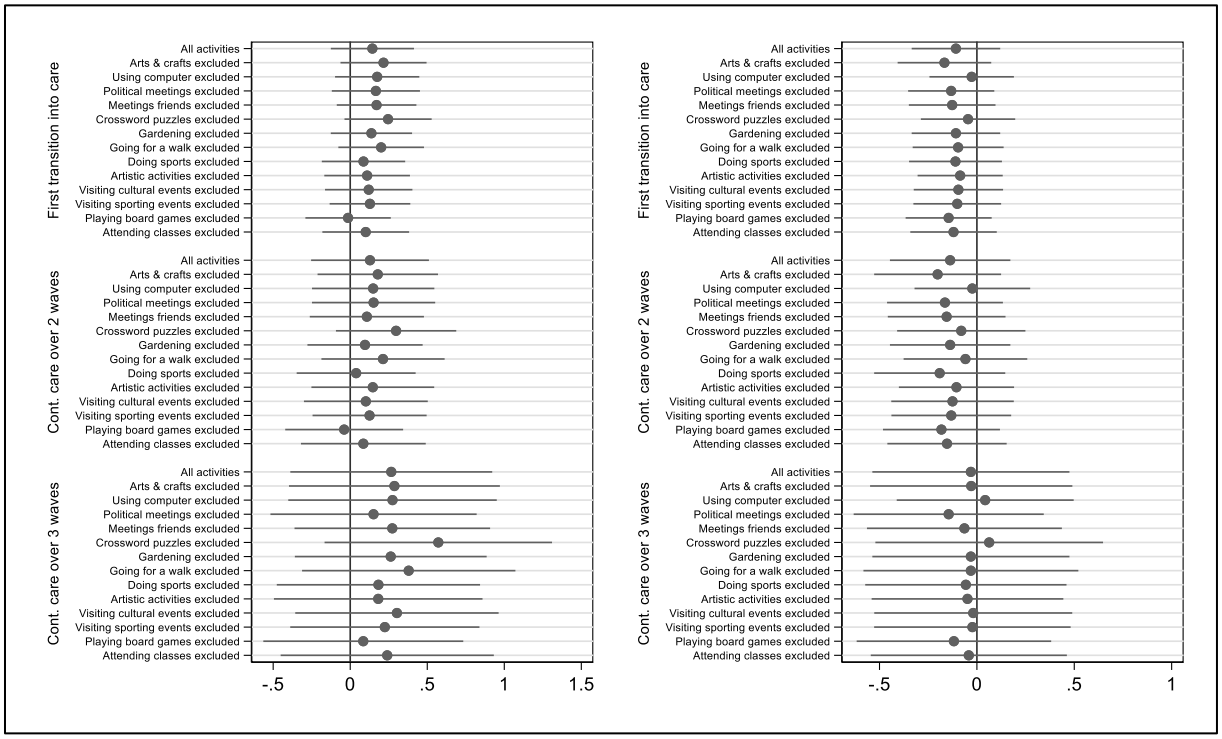
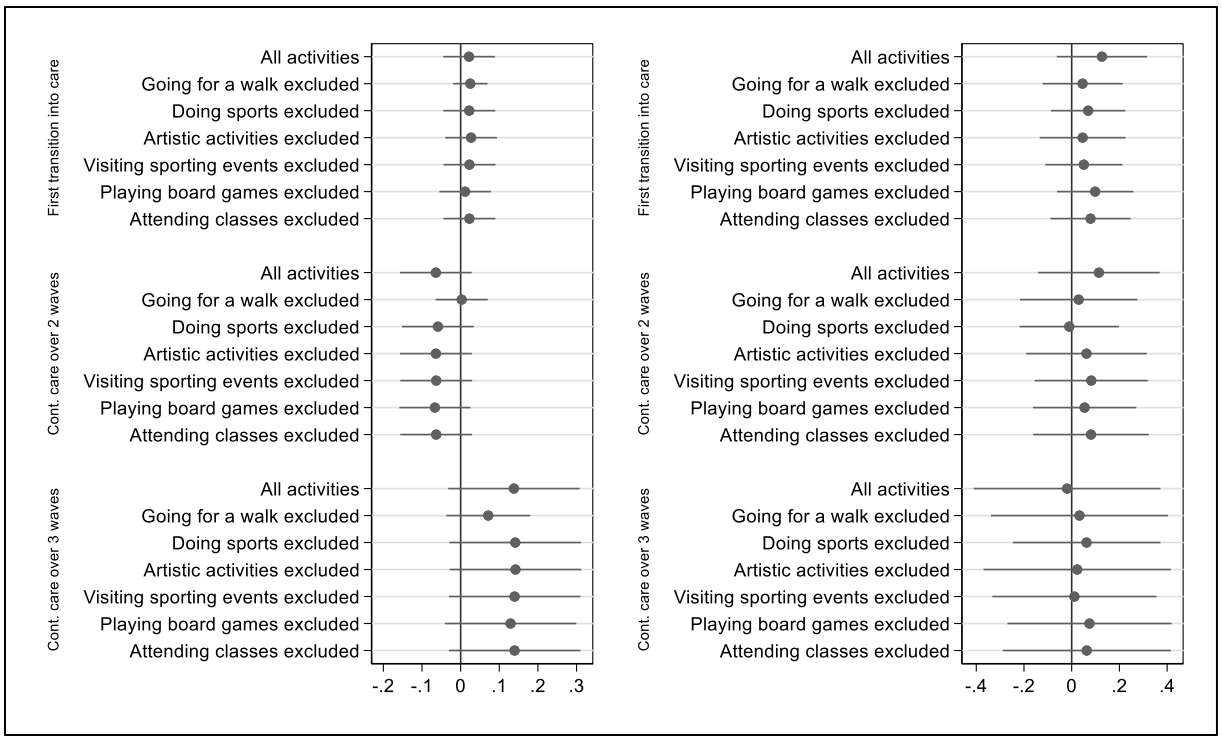


Figure A12: Coefficients and 95% confidence intervals of **grandchild care** on doing at least one activity with relatives (left panel) and number of activities done with friends or others (right panel), from linear fixed-effects regression among **women**



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